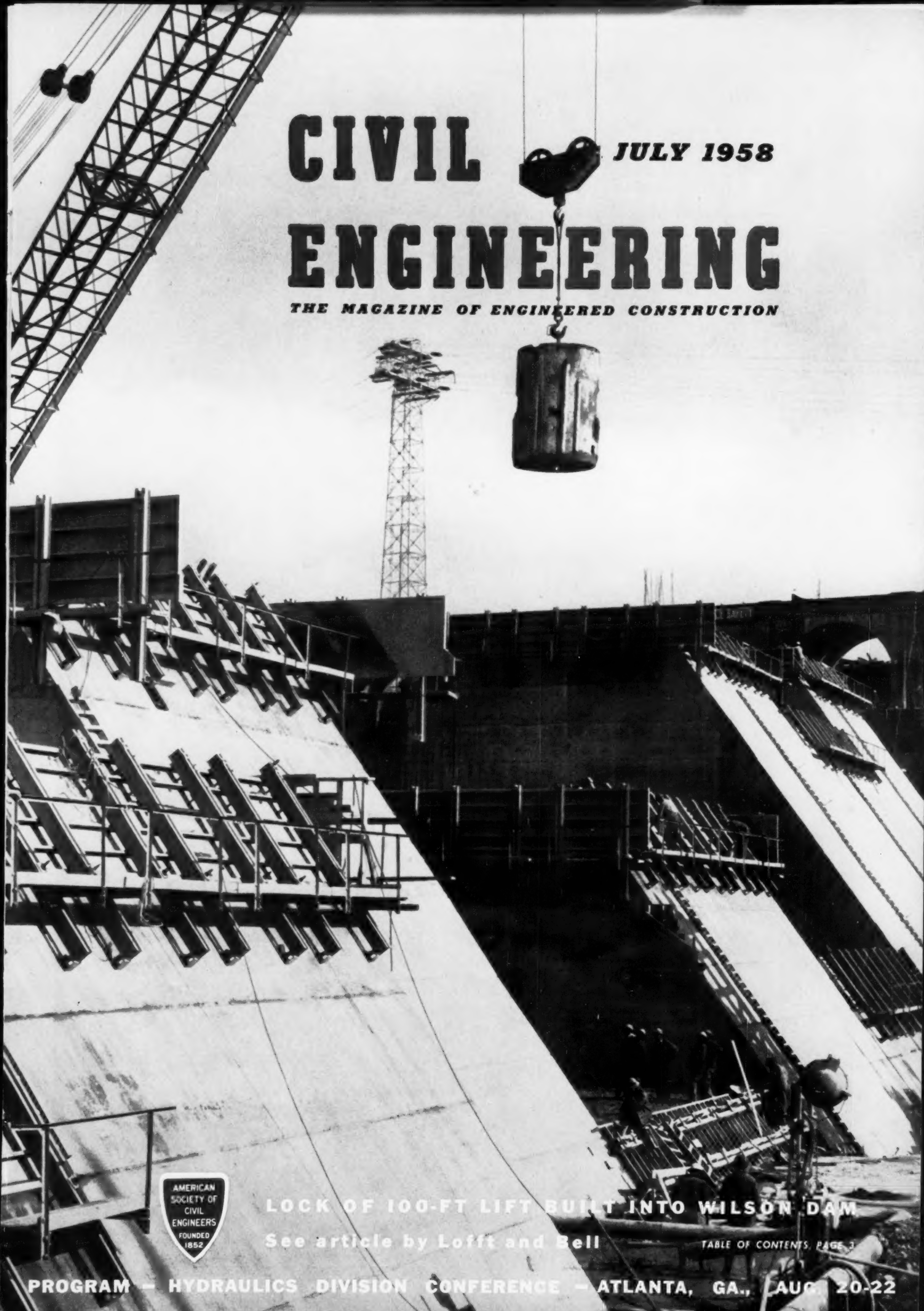
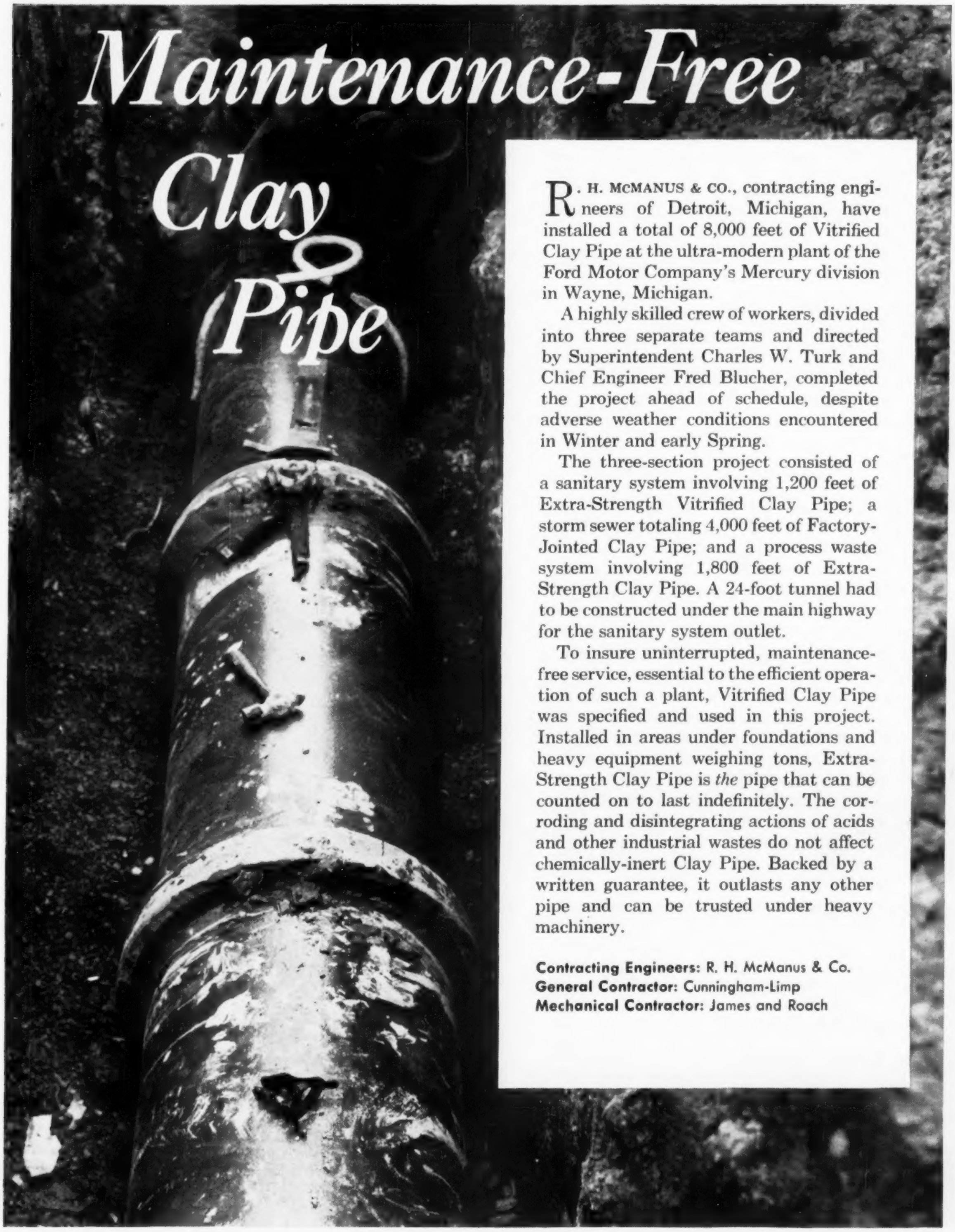


CIVIL ENGINEERING
JULY 1958
THE MAGAZINE OF ENGINEERED CONSTRUCTION
AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852
LOCK OF 100-FT LIFT BUILT INTO WILSON DAM
See article by Lofft and Bell
TABLE OF CONTENTS, PAGE 3
PROGRAM — HYDRAULICS DIVISION CONFERENCE — ATLANTA, GA., AUG. 20-22



R. H. McMANUS & CO., contracting engineers of Detroit, Michigan, have installed a total of 8,000 feet of Vitrified Clay Pipe at the ultra-modern plant of the Ford Motor Company's Mercury division in Wayne, Michigan.

A highly skilled crew of workers, divided into three separate teams and directed by Superintendent Charles W. Turk and Chief Engineer Fred Blucher, completed the project ahead of schedule, despite adverse weather conditions encountered in Winter and early Spring.

The three-section project consisted of a sanitary system involving 1,200 feet of Extra-Strength Vitrified Clay Pipe; a storm sewer totaling 4,000 feet of Factory-Jointed Clay Pipe; and a process waste system involving 1,800 feet of Extra-Strength Clay Pipe. A 24-foot tunnel had to be constructed under the main highway for the sanitary system outlet.

To insure uninterrupted, maintenance-free service, essential to the efficient operation of such a plant, Vitrified Clay Pipe was specified and used in this project. Installed in areas under foundations and heavy equipment weighing tons, Extra-Strength Clay Pipe is *the* pipe that can be counted on to last indefinitely. The corroding and disintegrating actions of acids and other industrial wastes do not affect chemically-inert Clay Pipe. Backed by a written guarantee, it outlasts any other pipe and can be trusted under heavy machinery.

Contracting Engineers: R. H. McManus & Co.
General Contractor: Cunningham-Limp
Mechanical Contractor: James and Roach

C-158-3

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, California • Box 172, Barrington, Illinois • 206 Mark Bldg., Atlanta 3, Georgia

Civil Engineering, July 1958, Vol. 28, No. 7 • Published monthly by the American Society of Civil Engineers.
Publication office Concord, New Hampshire. (Second-class mail privileges authorized at Concord, New Hampshire.)

EDITORIAL & ADVERTISING DEPARTMENTS at ASCE Headquarters, 33 West 39th Street, New York 18, N.Y.

Advertising Representatives
are listed on Index to Advertisers page

Subscription Rates—Price 50 cents a copy. $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents, and postage to all other countries outside of the United States and possessions, $1.50 additional.

Member Audit Bureau of Circulations

46,100 copies of this issue printed

CIVIL ENGINEERING

JULY 1958
VOL. 28 • NO. 7

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• ARTICLES

• SOCIETY NEWS

• NEWS BRIEFS

• DEPARTMENTS

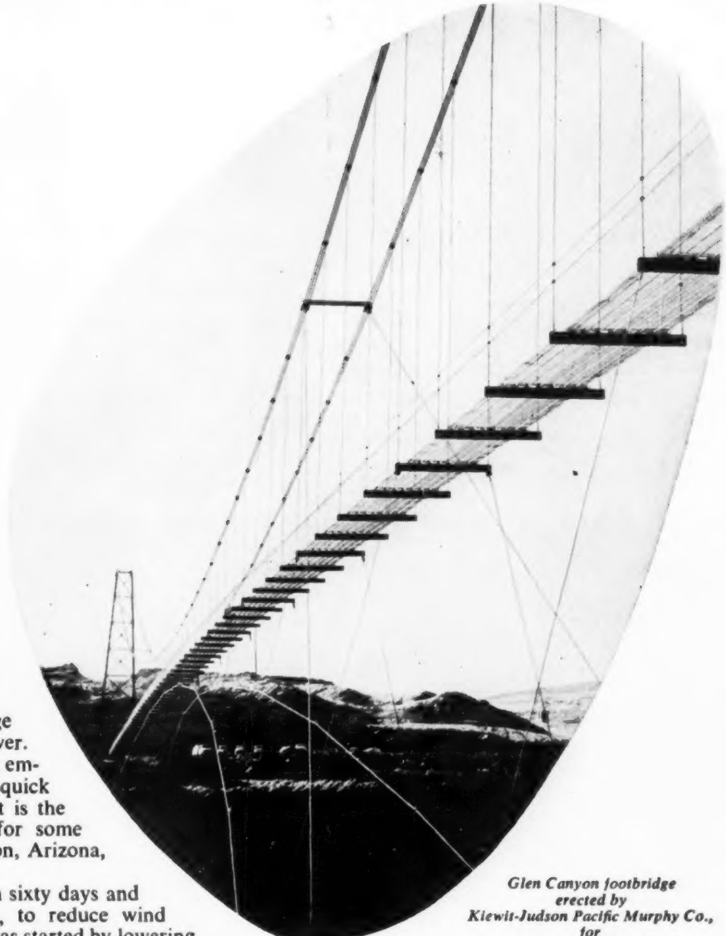
ROEBLING

BRIDGE STRAND

SPANS A CANYON

TO MAKE

The Longest Footbridge in the U. S.

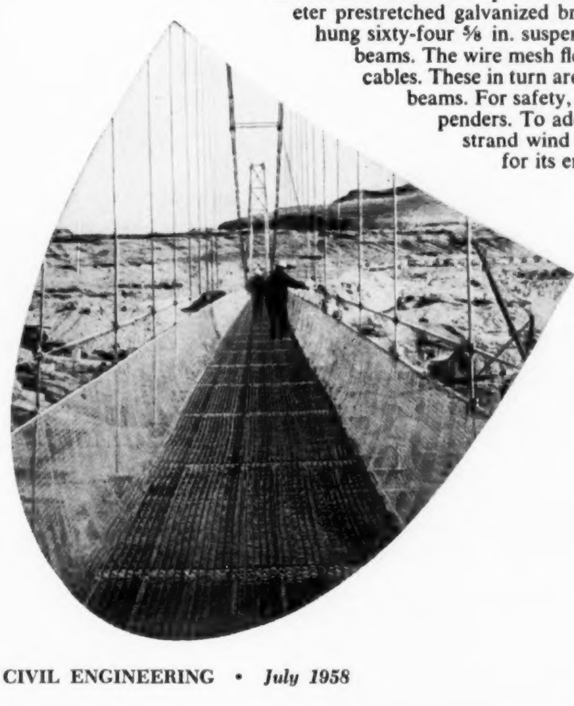


Glen Canyon footbridge erected by Kiewit-Judson Pacific Murphy Co., for Merritt-Chapman & Scott Corp., prime contractor for the Glen Canyon Dam.

Seven hundred feet above the Colorado River at the Glen Canyon Dam site in northern Arizona, this suspension bridge extends 1280 feet from tower to tower.

Designed as a walkway for project employees only, it provides ready and quick access to both sides of the river. It is the only span across the Colorado for some 200 miles between Marble Canyon, Arizona, and Moab, Utah.

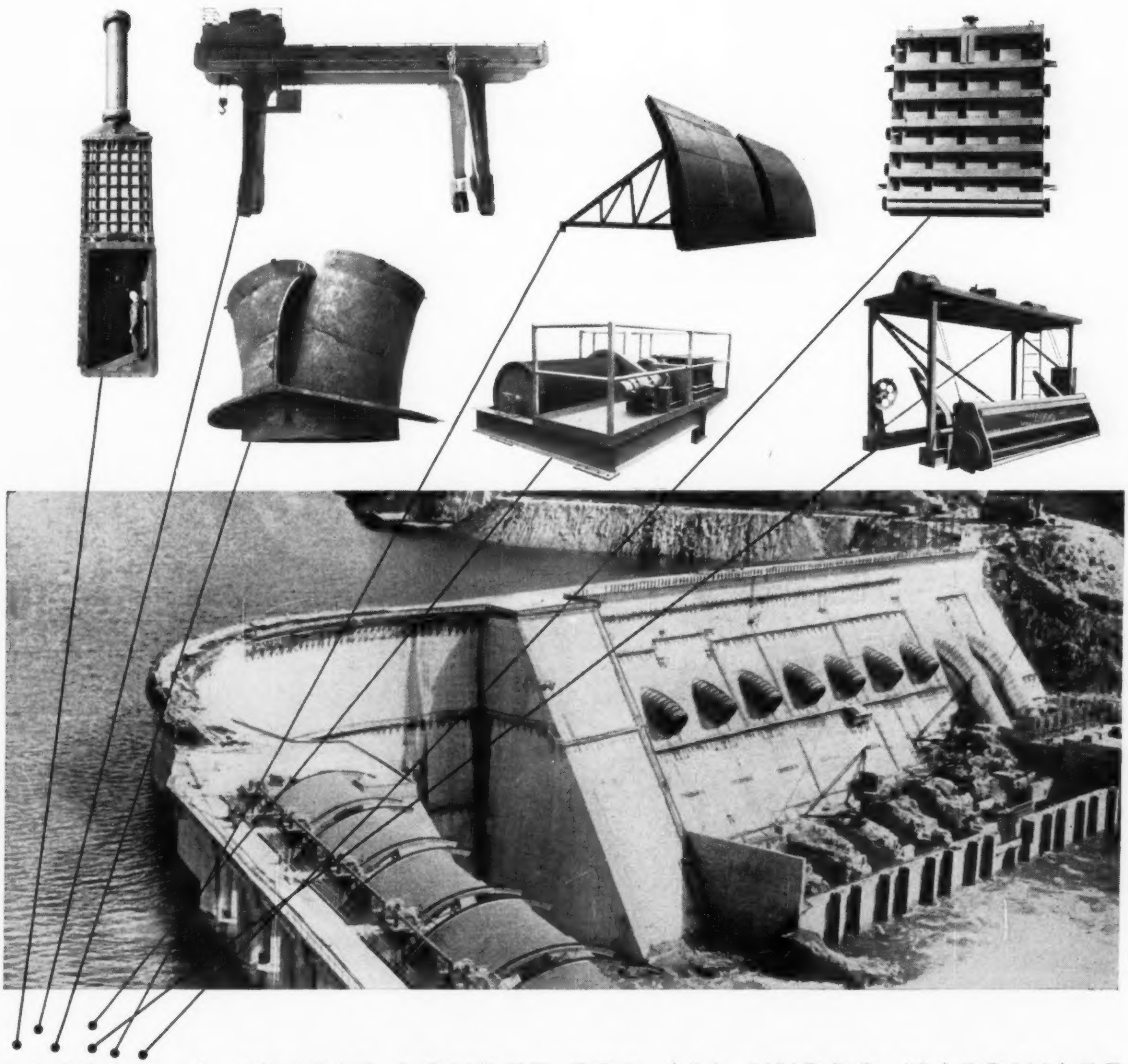
The bridge was completed in sixty days and features a steel mesh deck, to reduce wind resistance. Construction was started by lowering two ⅝ in. cables to the bottom of the west side of the gorge, transporting them across the river by boat and raising them on the east side by block and tackle. The six main suspension cables are 1¾ in. diameter prestretched galvanized bridge strands. From them are hung sixty-four ⅝ in. suspenders, attached to 7 ft-wide floor beams. The wire mesh floor is laid on eight 1 in. diameter deck cables. These in turn are supported every twenty feet by the floor beams. For safety, four handrail cables are attached to the suspenders. To add stability in strong winds, two 1¾ in. bridge strand wind brace cables run below the deck on either side for its entire length.



This is an extremely long example of Roebling's readiness to supply bridge strand for any kind of bridge or suspension structure. Add engineering facilities and experience that are immediately applicable to any suspension problem, and you have the combination of product and knowledge that make Roebling the leader in the design and erection of suspension systems of *every* description. Your inquiries on any and all phases of suspension by wire rope or strand are invited. Bridge Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation



PACECO—A SINGLE SOURCE FOR ALL HYDRO HARDWARE

One order does it. *One* responsibility for the design and construction of cranes, hoists, gates, trash rakes, valves, draft tubes, conduits, penstocks and fittings. Operating efficiency of each unit is maximized...initial costs are reduced because *all* parts can be coordinated in *both* design and fabrication. PACECO can work with your specifications or assist you at the designing stage. You benefit from the skills, experience, and research which have made PACECO a recognized leader in the field of power project equipment. Call or write your nearest PACECO office or representative today. For more information about PACECO's services to the power industry write for brochure 7-B.

35TH YEAR PACECO

PACECO
"TAILORS OF STEEL"®

PACIFIC COAST ENGINEERING CO.

Alameda, California • **New York 17, N. Y.**
P.O. Drawer "E" — 51 East 42nd Street
LAkehurst 2-6100 — OXford 7-1475

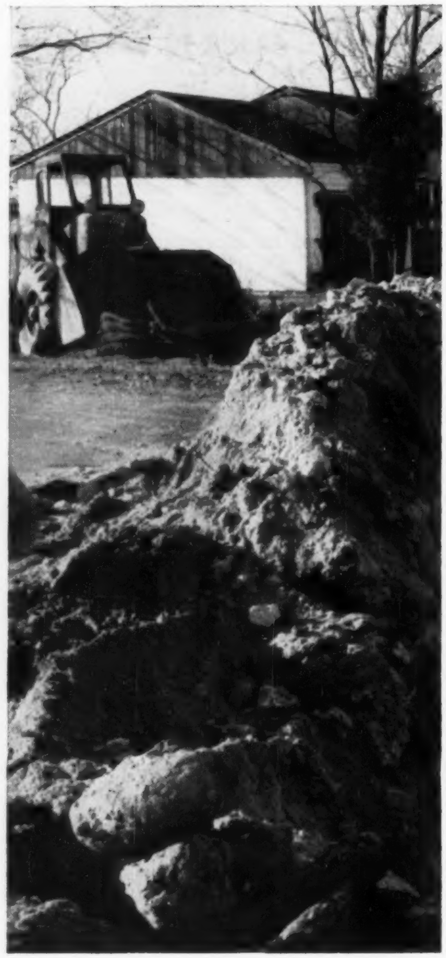
REPRESENTATIVES: **Pasadena 8, Calif.,** 774 East Green St., RYan 1-6663 • **Houston 1, Texas,** P. O. Box 1035, MOhawk, 4-3504.

4837

"Transite's installation recent increases

Says Philip J. Holton, Jr.
Chief Engineer
Water Supply Board
Providence, R.I.

"Our records show that labor and material costs have increased 100% since 1946. Yet, in this same period of time, our installation costs have increased only 21%. The ease of handling and speed with which contractors can lay Transite Pipe enable us to take full advantage of modern equipment and methods. In this way, Transite has played a prominent part in helping us offset increased costs."



Transite Pressure Pipe helps you cut system costs 3 ways: in design ... installation ... operation!

Today, in every part of the nation, municipal and consulting engineers choose Transite® Pressure Pipe. Ask why, and you find that economy is always among the Transite advantages they consider most important. For no pipe does so much to help keep your costs low in three different areas:

1. Design. Transite lets you plan a system for maximum efficiency. For its high carrying capacity (flow coefficient, C-140) often lets you specify pipe of smaller diameter. And because Transite's smooth interior remains smooth, you never need to make costly allowances for future reduction in carrying capacity.

2. Installation. Transite's installation speed cuts time and labor costs substantially. Light in weight for so durable a pipe, it handles easily above and below ground. And its Ring-Tite Coupling assembles quickly, surely . . . giving you a tight seal at every coupling in the system.

savings have helped us absorb in labor and material costs..."

Crews of Fanning and Doorley Construction Co. installing 8" line in Providence, R. I.

3. Operation. Here's where Transite really saves! For its maintained carrying capacity keeps pumping costs low year after year. Its strength, durability and corrosion resistance cut maintenance to a minimum, provide years of trouble-free service.

Transite's Ring-Tite Coupling cut away to show how rubber rings are compressed and locked in place to form a tight yet flexible joint.

We'll be pleased to send you booklet TR-160A. Write Johns-Manville, EN Box 14, N. Y. 16, N. Y.

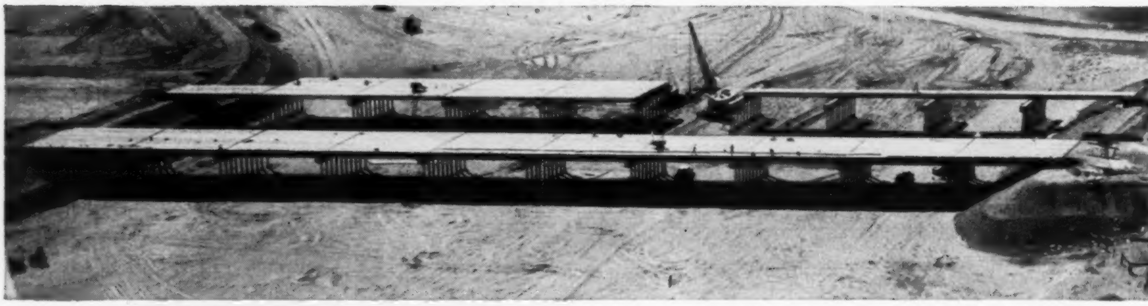
"Good Water, the Lifeblood of your Community" Let's promote it—Let's have it!

JOHNS-MANVILLE

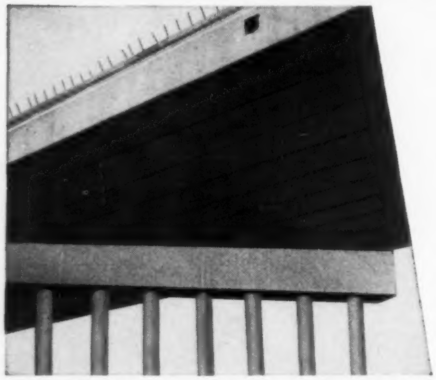
100 YEARS OF QUALITY PRODUCTS . . . 1858—1958

JOHNS-MANVILLE JM PRODUCTS

AMDEK Bridge Beams
speed superhighway construction



Dual lane highway bridges, constructed with prestressed pretensioned Amdek Beams, near completion in Socorro County, New Mexico. Erected for the New Mexico State Highway Department as part of the Federal Interstate Program.



Low depth-to-span ratio means less weight, greater clearance and reduced fill. Smooth underdeck offers minimum resistance to flood debris.

Another example of

Progress in Concrete

Amdek Superstructures—available in lengths up to 100 feet or even more—can cut bridge building time from weeks to days or days to hours! Prestressed, pretensioned, and with specially designed voids, Amdek Sections are lighter and more rigid for better, easier handling . . . provide a stronger combination deck and loading member.

Precast Amdek is rapidly placed in any weather and assures a bridge of beauty for years without painting or other maintenance. Materials are readily available . . . plants are strategically located for fast delivery anywhere—to bring you "Tomorrow's Bridge" today.

American-Marietta's experts in the design and manufacture of prestressed and precast concrete bridge members—including Amdek, I-Beams and Channel Slabs—can help *you* save considerable time and money.

200 Amdek Box Girders used to build 506 foot bridges on 30° skew. Independent dynamic and static load tests prove superior strength of Amdek Skew Beams.

Write today for illustrated literature.

A-M

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

56 Reasons Why Vulcan's the Choice for Service

If you use aggregates and have schedules to meet, on time and economically, you'll appreciate Vulcan's multiple sources of supply.

From the Gulf to the Great Lakes, Vulcan Materials Company operates fifty-six quarries, stone crushing and slag plants . . . your assurance of service whenever and wherever you need it.

Teamed with Vulcan's efficient, friendly and service-minded staff of experts, this assures you of a new standard of service, never before available in the essential aggregate industry . . . serving those who are helping to build America.

"Organized for Service"

Vulcan Materials Company

P O Drawer 155 · Birmingham 2, Ala.

THIS IS VULCAN MATERIALS COMPANY:

Birmingham Slag Division
Brooks Sand & Gravel Division
Chattanooga Rock Products Division
Concrete Pipe Division
Consumers Company Division
Lambert Bros. Division
Montgomery-Roquemore Gravel Division
Stockbridge Stone Division
Vulcan Detinning Division
Frontier Chemical Company
Teckote Corporation
Wesco Contracting Company

NEWS OF ENGINEERS

W. F. Smith, partner in the Houston, Tex., consulting firm of Howe and Wise, is the author of *Diamond Six* which has just been published by Doubleday & Company. In this interesting volume Mr. Smith tells the story of his grandfather, pioneer Texas rancher, sheriff, Texas Ranger, and founder of the famous Diamond Six cattle ranch, which has been in the Smith family for over a century. Early in June, Mr. Smith's home town of Conroe held a large autographing party at the ranch to celebrate publication of the book.

James J. Doland, professor of hydraulic engineering at the University of Illinois, has retired after 32 years with the university. **Thomas Shedd,** professor of structural engineering, has also retired from the university staff. Both men have authored and co-authored textbooks in their respective fields.

Frank E. Alderman and **Frank M. Swift** announce the incorporation of Alderman and Swift, Engineers. The new firm succeeds Frank E. Alderman, Consulting Engineers, and will continue with offices at 1520 Oxley Street, South Pasadena, Calif.

Charles E. Clark has accepted a position as sanitary engineer with the Illinois Health Department. His office will be located in Springfield. Mr. Clark was formerly regional engineer with the Louisiana State Department of Health.

Lindsey J. Phares has been elected vice-president in charge of domestic construction for Raymond International, Inc. Mr. Phares has been with Raymond since 1941. He has been field engineer, general superintendent, assistant manager of domestic construction, and this past year assistant vice-president of domestic construction.

L. J. Phares

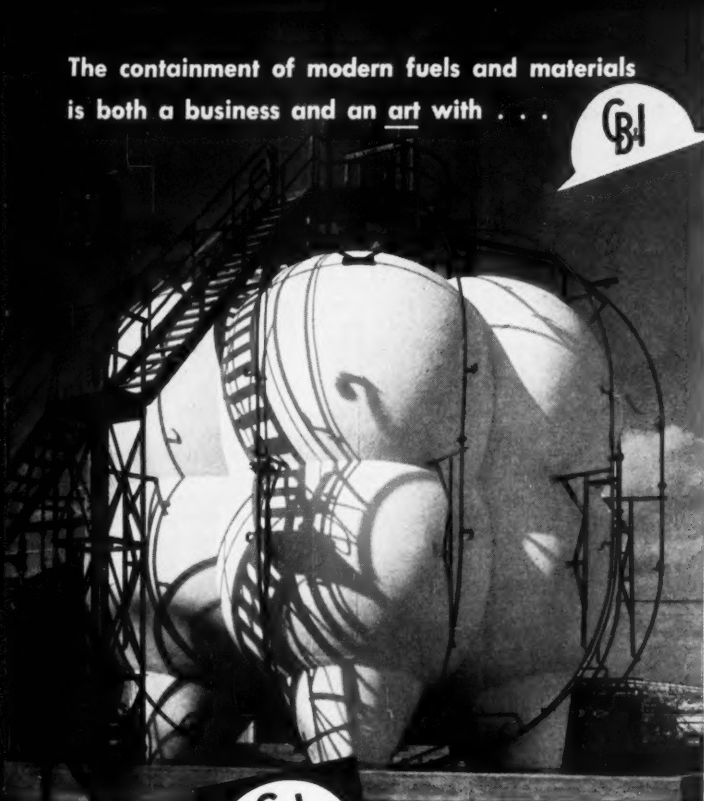
Harvey B. Leaver has been appointed midwestern division sales manager of Armco Drainage & Metal Products, Inc., with headquarters in Topeka, Kans. Mr. Leaver has been with Armco for ten years, previously serving as sales manager for Kansas and Missouri.

Karl J. Wagoner has retired as chief engineer of the Baltimore and Ohio Railroad, Baltimore, Md. Mr. Wagoner has been with the railroad ever since his graduation from West Virginia Wesleyan College in 1917. As chief engineer for the past five years, he has supervised design and construction of $37,000,000 worth of improvements.

Philip G. Griffin announces the opening of a civil engineering office at 1668 North Garey Avenue, Pomona, Calif. From his new office, Mr. Griffin will offer building design services for architects and contractors. Prior to the opening of his office, Mr. Griffin was associated with the Pascoe Steel Corporation, also of Pomona.

Joseph D. Blatt has taken on the responsibilities of regional administrator for the Civil Aeronautics Administration, Washington, D. C. Mr. Blatt has served with the Administration since 1937 and has been regional deputy administrator since 1956. He is a recent chairman of the ASCE Air Transport Division.

(Continued on page 22)

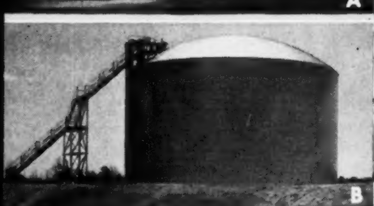


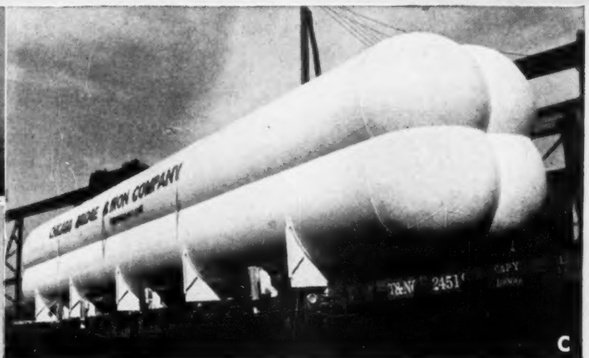
Chicago Bridge & Iron Company offers a complete and fully coordinated facility for the engineering, fabrication and erection of structures and vessels to contain and store modern fuels, chemicals and other process materials: in gas or liquid form, at high or low pressures, and at high or low temperatures.

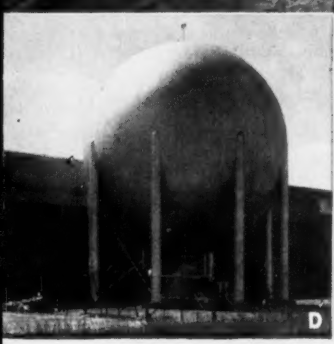
Included in the CB&I Services are facilities for metallurgical control, stress-relieving, X-ray and welding—and techniques developed during nearly 70 years of service to industry. Five strategically located CB&I plants are staffed and equipped to serve your *specific* requirements for corrosion resistant metals for solid, lined or clad steel, alloy or non-ferrous construction.

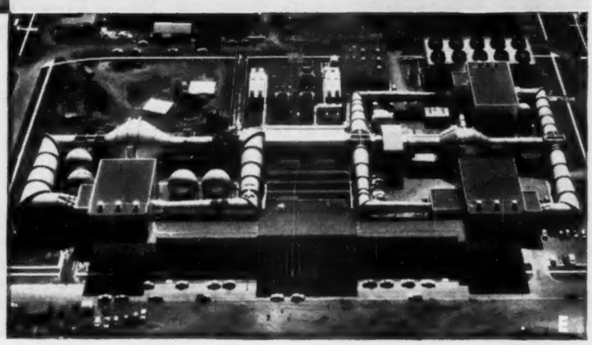
A few typical installations are shown and described below. Of particular interest, is HORTONCLAD®—a new vacuum bonding process which makes it possible for CB&I to produce composite plates in a larger range of combinations than has previously been available. Write our nearest CB&I office for the new bulletin on *Hortonclad* and literature on *CB&I Special plate structures.*

See CB&I for Creative CRAFTSMANSHIP IN STEEL









TOP, LEFT—14-lobe MULTISPHERE designed, fabricated and erected by CB&I to store 100,000 gallons of liquid methyl chloride at 150 lbs. working pressure. Design offers optimum versatility for pressure vessels.

A—5052 ALUMINUM was used for these ammonium nitrate storage tanks.

B—LIQUID PROPANE is stored by refrigeration at 1½ lbs. working pressure at minus 44° F in this unique 70-ft. diameter tank, designed and built by CB&I.

C—MULTICYLINDER Multi-lobe pressure vessels such as this offer advantage of high pressure storage where space is limited. Vessel is designed for 250 lbs. working pressure.

D—VACUUM SERVICE is provided by Hortonsphere® at a University of Toronto wind tunnel installation.

E—TUNNEL SECTIONS for wind tunnel were fabricated and erected by CB&I. A supersonic wind tunnel for Convair Division of General Dynamics was recently completed by CB&I as a "turnkey" project.

PRESSURE VESSELS • REFRIGERATED STORAGE • VACUUM SERVICE • HORTONCLAD® • ENGINEERING • FABRICATION • ERECTION IN ALL METALS AND COMBINATION METALS

Chicago Bridge & Iron Company

CB&I

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.) • New Orleans
New York • Philadelphia • Pittsburgh • Salt Lake City • San Francisco • Seattle • South Pasadena • Tulsa

Plants in: BIRMINGHAM, CHICAGO, SALT LAKE CITY, GREENVILLE, PENNSYLVANIA and at NEW CASTLE, DELAWARE
In Canada: HORTON STEEL WORKS LTD., TORONTO, ONTARIO
Representatives and Licensees: Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

E58CB

News of Engineers

(Continued from page 20)

L. Austin Wright, of Montreal, Canada, has retired as general secretary of the Engineering Institute of Canada, after 20 years in the post. He is succeeded by Dr. G. T. Page, former general manager and secretary of the Chemical Institute of Canada.

Nathan W. Dougherty, dean emeritus of engineering at the University of Tennessee, has received the 1958 National Society of Professional Engineers Award. Mr. Dougherty, who is now connected with the Arnold Engineering Development Center, received the award "in recognition of his outstanding leadership in his profession . . . his sympathetic encouragement of students of engineering, his zealous promotion of the ideals and principles of his profession . . ."

Kenneth B. Keener has retired as chief designing engineer of the Bureau of Reclamation, Denver, Colo., after 47 years with the Bureau. Mr. Keener joined the Bureau immediately after his graduation from Ohio Wesleyan University, and has held the post of chief designing engineer since 1952. Mr. Keener directed the design of Trinity Dam, the world's highest earthfill structure, now being built on the Central Valley. For a number of years, he was chairman of the U.S. National

K. B. Keener

L. G. Puls

Committee of the International Commission on Large Dams. Succeeding Mr. Keener is **Louis G. Puls.** In his new position, Mr. Puls will be the principal assistant to the assistant commisioner and chief engineer in all design matters. He will be responsible for all design activities of the Bureau in 18 states. Mr. Puls has been with the Bureau since 1933.

Benjamin E. Gay has opened a consulting office at 107 East Bay Street, Savannah, Ga. Mr. Gay's firm, Hadsdell and Gay, offers general civil engineering services.

Fred J. Benson, professor of civil engineering at the Texas Agricultural and Mechanical College, has been named dean of engineering at the college. Professor Benson has served as director of the Texas Transportation Institute and associate director of the Engineering Experiment Station at the College.

Two ASCE members are among the six prizewinners in the Dravo Corporation's Nineteenth Annual Technical Papers Competition. **F. J. Larkin,** plant and research engineer in the Contracting Division, won first prize of $500 with his paper discussing the plans for the new Markland navigation locks. Second prize of $300 went to **F. R. Burde,** sales engineer in the Machinery Division's New York office, for his paper, "Sewage Treatment Plant for a Modern Shopping Center."

Elsie Eaves, manager of the business news department of *Engineering News-Record,* was awarded honorary membership in Chi Epsilon at a recent meeting in Boulder, Colo. The occasion of the presentation was the Colorado Section's meeting with the Student Chapters at the University of Colorado, Colorado State University, and the University of Denver. Miss Eaves was the featured speaker. She was the first woman member of ASCE, which she joined as an Associate Member in 1927.

George A. Marston, dean of engineering at the University of Massachusetts, has been honored with an honorary doctorate of engineering from Worcester Polytechnic Institute. Dean Marston is an alumnus of Worcester.

AWWA Makes Annual Awards

Many ASCE members were among those receiving awards during the recent seventy-eighth convention of the American Water Works Association. Elected to honorary membership were **Fred G. Gordon,** assistant chief engineer, Chicago Department of Public Works and **Victor M. Ehlers,** director of the Division of Sanitary Engineering in the Texas State Department of Health. For outstanding contributions to the field of water works, **Ray L. Derby,** principal sanitary engineer in the Los Angeles Department of Water and Power, received the John M. Diven Medal. Honored for important papers were **Jerome B. Wolff,** chief of the Bureau of Engineering, Baltimore County Department of Public Works; **Hyman H. Gerstein,** assistant chief water engineer, Chicago Department of Water and Sewers; and **Harvey O. Banks,** director, California Department of Water Resources, Sacramento, were honored with Division Awards. Recipients of the George Warren Fuller Awards for distinguished service in the water works industry are **Quentin M. Mees,** civil engineering department, University of Arizona; **Albert G. Fiedler,** assistant chief, Water Resources Division, U. S. Geological Survey; **Paul D. Haney,** sanitary engineer, Black & Veatch; **Garvin H. Dyer,** manager, Missouri Water Company; **George J. Schroepfer,** professor of sanitary engineering, University of Minnesota; **Raymond H. Fuller,** partner, Burgess & Niles; and **Thomas J. Blair, Jr.,** president and general manager, West Virginia Water Service Company.

Alvin F. Meyer, Jr., senior industrial hygiene engineer in the Office of the Surgeon, Headquarters with the Strategic Air Command at Offutt Air Force Base in Nebraska, has been appointed assistant professor of preventive medicine and public health in the Creighton University School of Medicine, Omaha, Nebr. Colonel Meyer has been a guest lecturer at the university for the past three years.

Carl W. Keuffel, president of the Keuffel and Esser Company in Hoboken, N. J., has been awarded an honorary degree of doctor of engineering from Stevens Institute of Technology, in Hoboken. Mr. Keuffel, a 1911 graduate of Stevens, received the degree at recent commencement exercises.

C. B. Welch has been promoted to assistant manager of works at the Bethlehem Steel's Company's Pottstown, Pa., fabricating plant. Mr. Welch previously served as assistant to the retiring works manager.

Willard L. Lauer has been elected president and treasurer of the Trimble Company in Pittsburgh, Pa. Mr. Lauer, a veteran in the construction industry, was formerly associated with the Rust Engineering Company. The Trimble Company which celebrates its centennial this year, is the oldest general contracting firm in western Pennsylvania.

W. L. Lauer

G. E. Villena has established an engineering firm, in Westwood, Ohio. The new firm will offer a consulting service in the fields of civil and structural engineering. Previously Mr. Villena was connected with A. LeFeber and Associates.

Kenneth F. Ward has been appointed divisional sales manager for the Pantex Manufacturing Corporation of Pawtucket, R. I. He will have headquarters in Washington, D. C., and will contact government agencies at Federal and state levels. Previously Mr. Ward was with the Prosperity Company in Washington.

Edmund J. Cantilli has been promoted to highway project planner with the Port Development Department of the Port of New York Authority in New York City. Mr. Cantilli formerly served as traffic engineer in the Operations Services Department. In his new capacity, he will be in charge of the functional design of highway projects under the jurisdiction of the Port Authority.

(Continued on page 24)

(Continued from page 23)

Walter S. Todd, bridge construction engineer with the Kentucky State Highway Department, Frankfort, has retired after a career of almost 30 years. Mr. Todd, who has headed bridge construction for the State since 1946, began his work with the department as a designer.

Joe S. Robinson has been named to fill the new post of assistant chief engineer with the Delaware State Highway Department. In his new position, Mr. Robinson will be responsible for procedural decisions. He has had 22 years of highway experience and has been with the Delaware Highway Department for seven years. **Joseph Mickle Fox** will succeed Mr. Robinson as bridge engineer with the department. Mr. Fox was with the Pennsylvania Railroad for 43 years until his retirement last March.

Robert L. Sanks has accepted the post of chairman of the Civil Engineering Department of Gonzaga University in Spokane, Wash. Professor Sanks has served as professor at the University of Utah and is a past president of the Intermountain Section of the Society.

Roscoe E. Van Liew has been assigned to the San Diego (Calif.) Naval Station as public works officer. Before transferring to San Diego, Captain Van Liew will complete his tour of duty as officer in charge of construction with the Bureau of Yards and Docks Contracts, Far East with his headquarters at the U. S. Naval Base in Yokosuka, Japan.

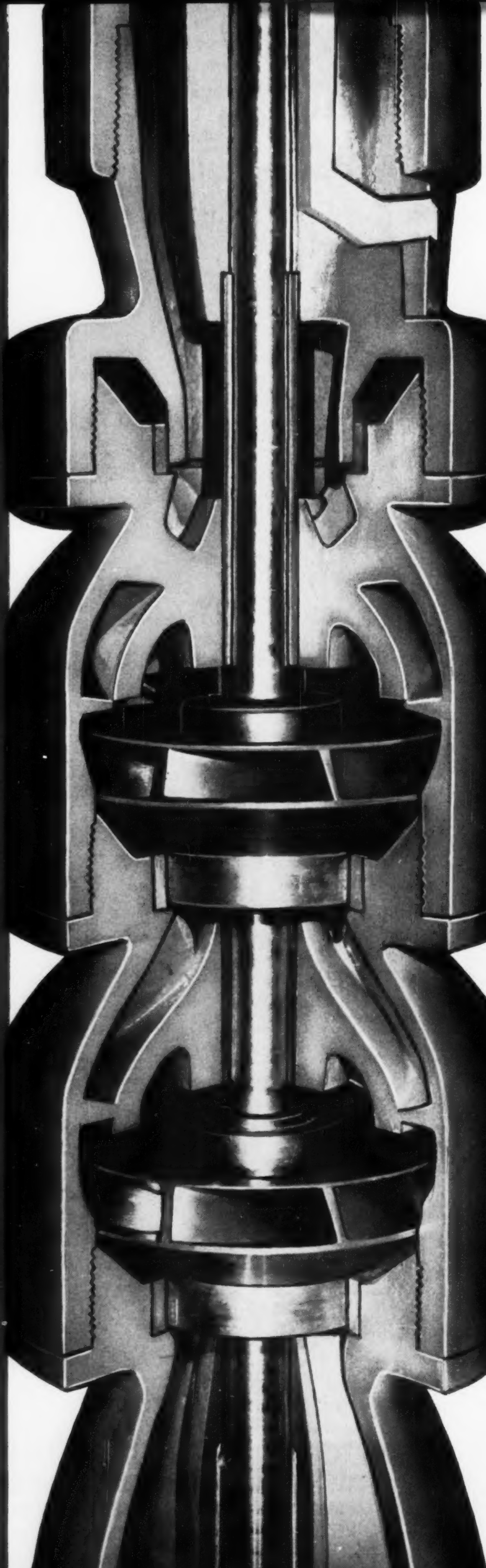
R. E. Van Liew

Walter L. Huber has been reelected chairman of the Advisory Board on National Parks, Historic Sites, Buildings and Monuments. In this position, he will serve the Secretary of the Interior. Mr. Huber, partner in Huber and Knapik in San Francisco, Calif., is a Past-President of ASCE.

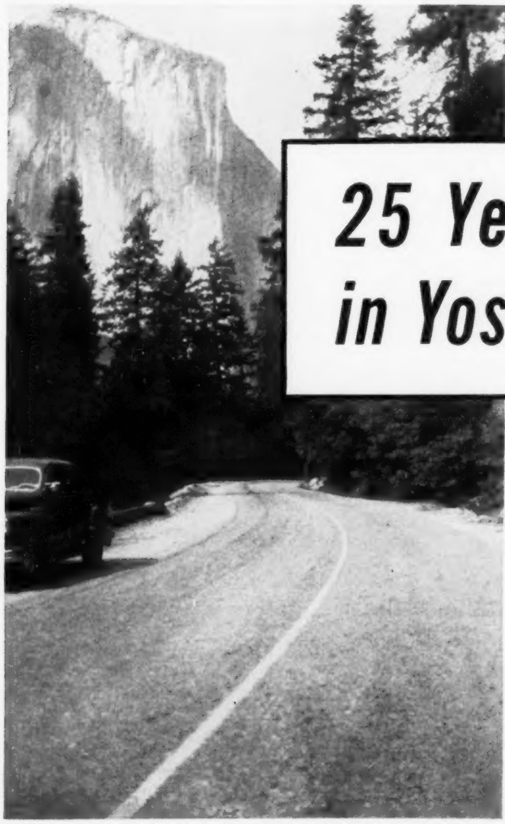
Joseph Dave, president of the Dave Steel Corporation, announces a change in the name of his firm. Originally the Oregonia Bridge Company, the new name will be the Dave Steel Company, with fabricating plants in Lebanon, Ohio, and Asheville, N. C.

William Whipple, Jr., Brigadier General, USA, has been transferred from Poitiers, France, to take the post of division engineer, Southwest Division, Corps of Engineers, in Dallas, Tex. General Whipple served as commanding officer of the Base Section, Communications Zone, during his tour of duty in France.

(Continued on page 120)



BITUMULS SURFACE TREATMENTS ARE REAL LIFE SAVERS*



25 Years of Good Roads in Yosemite National Park

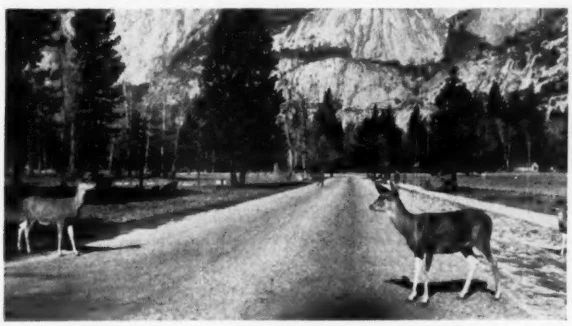
* By permission of Beech-Nut Life Savers, Inc., for candies

1933: Heavy-duty pavements of Bitumuls Penetration Macadam.

Just over 25 years ago, engineers of Yosemite National Park prepared for an expanded program of road surfacing. Located far from any hot-mix plants, they specified the then-new Bitumuls® Penetration Macadam type of construction.

This sound pavement provided excellent service, even in areas where snow, ice, and rigorous weather prevail for many months of the year. These roads in Yosemite are now open the year-around for winter sports enthusiasts.

With the improved road system, visitors came to the Park by hundreds of thousands. As a result of this heavier-than-anticipated traffic, combined with the severe weather, the need for an organized maintenance program became obvious. That's when the Park Engineers turned to Bitumuls Surface Treatment as a proved "life saving" maintenance tool.



1948: For 15 years, occasional Bitumuls Surface Treatments have kept pavements in top shape.

1957: Newly-introduced Bitumuls Slurry Seal also used for road and walk maintenance.

Bitumuls Surface Treatments not only successfully extended the life of the pavements, but also provided all-year, skid-proof, safe surfaces.

In 1957, Park officials employed another American Bitumuls development known as "Bitumuls Slurry Seal." This new technique is a very economical "life saver." It performs a "holding action" against weathering and further deterioration, permitting continued use of the pavement ahead of planned resurfacing.

American Bitumuls & Asphalt Company

320 Market St., San Francisco 20, California

Baltimore 3, Md.
Mobile, Ala.
Inglewood, Calif.
St. Louis 17, Mo.
San Juan 23, P. R.
Oakland 1, Calif.
Perth Amboy, N. J.
Cincinnati 38, Ohio
Tucson, Ariz.
Portland 8, Ore.

Call our nearest Bitumuls office for details on these paving and maintenance techniques, and for the "Bitumuls/Life Saver" story.

. . . . . Am-Soc Briefs

▶▶ One world of science and engineering. . . . Professional interests bring nations together when statesmen fail. An important cooperative effort is the forthcoming program of the International Association of Bridge and Structural Engineering and the ASCE Structural and Engineering Mechanics Divisions, which will bring some of Europe's most brilliant engineers to these shores this fall for the Society's Annual Convention. . . . After you have read up on the IABSE (Prof. Frank Baron's article in Society News) and seen the tentative program for the Convention (in Division Doings), be sure to let Chairman Michalos know if you plan to attend. A coupon on page 120 will make it easy to supply this information.

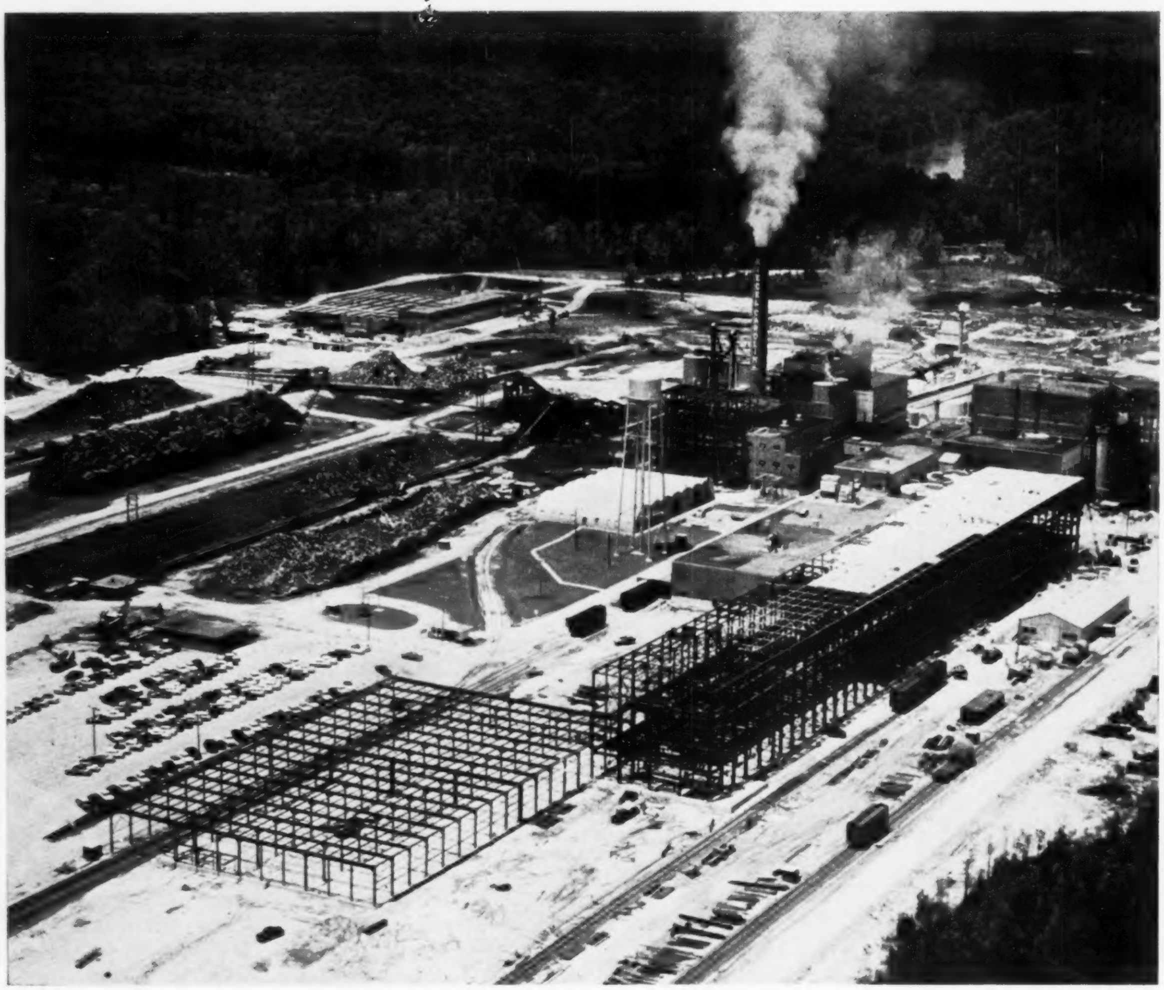
▶▶ Speaking of international meetings. . . . In store for engineers this fall is an important series of international meetings, which may be attended without the expense and red tape of going abroad. Montreal will be host to the Fifth Convention of the Pan American Federation of Engineering Societies (UPADI), September 3-6, and to a Sectional Meeting of the World Power Conference, September 7-11. New York City will entertain the Sixth International Congress on Large Dams, September 15-20. There will be three Study Tours to different parts of the country at the close of the Sixth Congress. . . . Details are available from the U.S. Committee on Large Dams, which may be reached through EJC, 29 West 39th Street, New York 18.

▶▶ Fifth Nuclear Congress. . . . Qualified engineers and scientists are cordially invited to prepare papers for the Fifth Nuclear Congress, which will be held in Cleveland next spring with ASCE as one of many sponsoring societies. The dates, April 5-10, may seem comfortably in the future. However, 300- to 500-word summaries of prospective papers are due by October 1. ASCE authors must clear their summaries through Executive Secretary Wisely.

▶▶ For the advancement of America's engineering leadership. . . . This is one of the slogans of the fund-raising campaign for the United Engineering Center. . . . Engineers are reminded that their contributions may be spread over three years and that they are deductible from taxable income. A table (page 72) suggests the range of member giving needed for success in financing the Center. To date ASCE members have contributed about $50,000 of their $800,000 share. . . . The chart showing the status of contributions (page 72) will be a regular monthly feature.

▶▶ Engineering salaries for the quarter ending May 15 remain largely unchanged. The slight increase indicated in the regional index largely reflects adjustments upward of a few agencies reporting low salaries in the past.

▶▶ Flash from the Portland Convention. . . . Philadelphia Consultant Francis S. Friel is the official nominee for 1959 President of ASCE. Mr. Friel, an international authority in the fields of water supply and purification, large dams, and power, is completing a term as Vice-President from Zone II. There will be more about him in the August issue.



do you know that

Engineers will continue in tight supply for at least another decade? In the long-range view of the National Science Foundation, "unless something is done to increase the supply or decrease the demand," there will be a deficit of 9,000 engineers by 1960 and of 10,000 by 1965. These estimates were revealed in the May issue of the ASEE's *Journal of Engineering Education* by Henry Armsby, chief of engineering education in the U.S. Office of Education.

• • •

Steel is still the leading building material in the nation's largest city? Over 80 percent of the buildings, 15 stories or over, erected in Manhattan since 1947 are steel framed—in the ratio of 9 out of 10 for office buildings and 3 out of 4 for apartment buildings. The city's biggest year was 1957, with 24 multi-story buildings; next was 1948, with 23 buildings; and least active was 1953, when only one building went up. All the structures combined used a total of 319,000 tons of steel. Source of these figures is the American Institute of Steel Construction.

• • •

The first water-desalting plant for a U. S. city has been authorized? Coalinga, Calif., has taken the significant step of ordering a 28,000-gpd electric membrane plant from Ionics, Incorporated, of Cambridge, Mass., for its separately distributed drinking and cooking water. The new plant will expand the city's potable supply by 50 percent by removing excess minerals from its plentiful but brackish well water. In the next ten years the plant is expected to save the city $400,000 over the cost of hauling fresh water 40 miles by rail. The need for salt-water conversion has just been recognized at national level, with Senate approval of a $10,000,000 appropriation for five pilot plants for experimenting with making sea and other brackish waters potable. The three units for converting sea water will have capacities of over 1,000,000 gpd, and the brackish water plants will have capacities of over 250,000 gpd.

• • •

The New York State Thruway had a record year in 1957? Contrary to expectations, the Thruway showed a surplus over operating expenses of more than $1,250,000 in 1957—its first full year of operation. Gross revenues were $31,064,076. The Authority's bond resolution, adopted in 1954, had estimated that 1959 would be the first year when earnings could be expected to meet expenses.

• • •

The atomic energy industry is a billion-dollar business? Sales of equipment and components for nuclear reactors are expected to total $4 billion in the next ten years. The Atomic Industrial Forum, in a recent growth survey of the industry, estimates that by 1960 the United States will have more than 500,000 ekw of nuclear power capacity. At the present rate of progress and with reasonably good luck, nuclear power competitive with conventional oil- or coal-produced power may be expected by 1964.

• • •

Plans for an English Channel tunnel have not been dropped? Under study and debate since 1802, the project is so much alive today that Chicago consultants, DeLeuw, Cather & Company have been retained to study the economic feasibility of a 40-mile tunnel under the channel. The exact location and nature of the tunnel are still not fixed. Decisions as to whether it will be for railway trains alone or for cars, too, will depend on the outcome of efforts to develop a satisfactory ventilating system. Piggy-back service, in which automobiles and trucks will be carried on railroad flat cars, is a possibility. Sponsor of the studies is the Groupement d'Etudes du Tunnel sous la Manche, composed of representatives of the Suez Canal Company, the French and British Channel Tunnel Companies, the International Road Federation (Paris office), and Technical Studies, Inc., of New York.

• • •

The Quebec, North Shore and Labrador Railroad is being rebuilt? The famous 356-mile line, pushed through the Canadian wilderness in the early fifties from Seven Islands on the St. Lawrence River to rich new iron-ore deposits at Knob Lake in Labrador, is being rebuilt with firmer fills, wider cuts, heavier bridges, and better alignment. In the meantime, the construction that was rushed to get shipments started is hauling some 13,000,000 tons of ore in a 165-day working season.

• • •

Some 1,286 miles of the Interstate Highway network are completed? A recent survey of State Highway Departments shows also that about 3,143 miles are currently under construction. The Texas Highway Department reports the largest completed mileage—223. North Carolina is second with 144 miles, and Washington third with 140 miles.

• • •

The $650,000,000 St. Lawrence Power Project has reached first completion stage? On July 1, a 600-ft-long earth and rock cofferdam across the north channel of the river between Barnhart and Sheek Islands will be breached by the explosion of 30 tons of dynamite. This will permit the river to flow through to fill the power pool reservoir behind Barnhart Island (International) Power Dam, where 81 ft of head will then be available to generate power. The rising waters behind the dam also will open up navigation around the dam through Eisenhower and Snell Locks and through Wiley-Dondero Canal on the New York side of the river.

Prepared from President Howson's Annual Address at ASCE Portland Convention

Good engineering, adequately communicated

Science and engineering always operate as a team. The scientist is concerned with the study of the forces of nature and the discovery of new knowledge. The engineer utilizes this knowledge and the forces and materials of nature for the welfare and advancement of mankind. As scientific discoveries have been made and incorporated into engineering practice, material things have been made to serve higher ends.

Why should this procedure be altered by the atomic and hydrogen bombs and artificial satellites? These developments hold great possibilities for good as well as for evil. By their very nature they make us think of wider areas, the whole of mankind, ultimate values and ultimate uses for human betterment. Science and technology have always worked for beneficial applications of their developments.

Certainly in the United States there must always be in the future as in the past an atmosphere favorable to technological progress. So long as that is maintained, America will always be in the forefront in such progress, and this will afford the greatest assurance that new developments will be utilized for human betterment.

If it be granted that we have and can maintain and develop the skills and techniques essential to keep this country in the vanguard of technological progress, what are engineers and scientists doing to encourage the use of their developments toward beneficial ends and to acquaint the public with technology's contributions to better living? On this point the engineering profession does not rate so high. Technology is not just a means of lightening labor. It produces more things for all with less labor and more relaxation for all.

In some degree the impression that engineers and scientists have created monsters they cannot control results from scientific aloofness from public affairs. A recent poll of members of the American Society of Civil Engineers by Opinion Research, Inc., disclosed that only 10 percent of the Society's members participate actively, and less than 50 percent participate at all in local, civic and community affairs. Yet engineers perform many public functions and their work is essential to the operation of our public economy. Their habits of accurate thinking and precise analysis promote intellectual integrity and make for truth and conscience, characteristics that can contribute to community as well as individual living. As a profession we are failing to accept and discharge our responsibilities in American society.

Certainly members of a profession trained to clear objective thinking, with a knowledge of the exact sciences and a record of their application to human progress, should be interested in public affairs. It is not enough that their works influence economic and social conditions. Credit for that frequently goes to the politician rather than to the engineer. As engineers fail to communicate to others the glamor of their professional work they lose deserved recognition and lessen their opportunities to serve humanity.

Where can engineering training and experience be better utilized and produce greater results in the public interest than by participation in public affairs at all levels?

Some engineering societies, including ASCE, are interested in national affairs along more or less restricted lines, but individual members are largely shirking their civic responsibilities while complaining about the status of engineers and the public relations efforts of the engineering societies. Public relations are only the composite of many individual human relations. Engineers Joint Council has recently adopted a concise definition of public relations as "Good performance, publicly appreciated because adequately communicated." The first and last parts of that definition—"good performance . . . adequately communicated"—are in our power and are an individual responsibility. The middle part, "publicly appreciated," is a consequence of the other two.

Technical progress recognizes no political boundaries. Engineers have contributed toward the shrinkage of distance and space which has so vitally affected world-wide contacts and economics. Engineers with their analytical approach to problems and their training in the evaluation of alternative procedures have a background valuable in directing public expenditures into the best channels both at home and abroad. The activity of the EJC in its two reports on a National Water Resources Policy is illustrative of an application of technical study to governmental expenditures. Such contributions should be more frequent and eventually should receive more consideration by government.

Engineers as individuals should assume their responsibilities in presenting in understandable terms the great possibilities inherent in utilization of our expanded techniques for humanitarian ends. They should participate, and thus attain recognition, in public affairs so as to guide in the programming of technological development along sound economic lines.

L. R. Howson

President of ASCE

FOUR-LANE RECTANGULAR

A four-lane vehicular tunnel under the Fraser River south of Vancouver, B.C., is being constructed by the trench method. Six 344-ft-long sections are being sunk in a prepared trench to make a 2,100-ft underwater tunnel. For the first time in North America—and the second time anywhere—a rectangular cross-section is being used. The success of the method depends on special equipment for jetting sand beneath the tunnel to give it firm support.

The open approaches extend right to the river banks, where the transition to the closed rectangular section of the subaqueous part of the tunnel is effected by ventilation buildings which house control equipment and ventilating fans. These buildings also serve as end bulkheads above the tunnel to close the river ends of the approaches.

In 1956, the British Columbia Highways Department, recognizing the need for a second major crossing of the Fraser River, retained Foundation of Canada Engineering Corporation Limited and Christiani & Nielsen of Canada Limited to design and supervise the construction of this four-lane vehicular tunnel.

The tunnel, capable of handling 7,000 vehicles an hour, will supplement the capacity of the Pattullo Bridge, upstream at New Westminster, opening the way for a new major freeway-type radial road emanating from Vancouver. The new crossing will effectively remove the confining influence of the Fraser River on the development of metropolitan Vancouver and will open great tracts of land for industrial, commercial and residential growth to the south of Canada's western seaport. See Fig. 1.

Careful engineering studies were made to determine the need for and proper location of the crossing. An appraisal of the relative merits of a bridge and a tunnel at the selected site indicated that a tunnel would provide the most economical solution. It was also found that a tunnel of the type proposed was better suited to the deep, loose sand of the foundation, would employ more local material, and could be completed more rapidly than a bridge. In meeting channel clearances for river navigation, the tunnel would

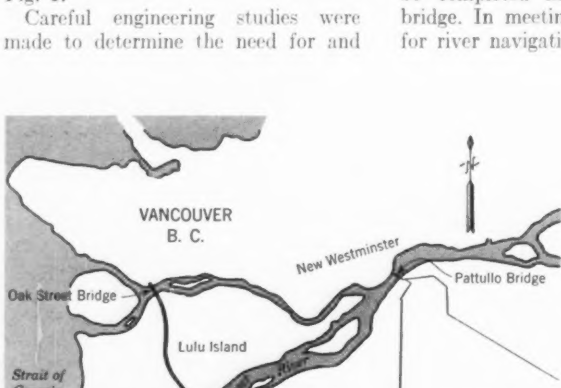
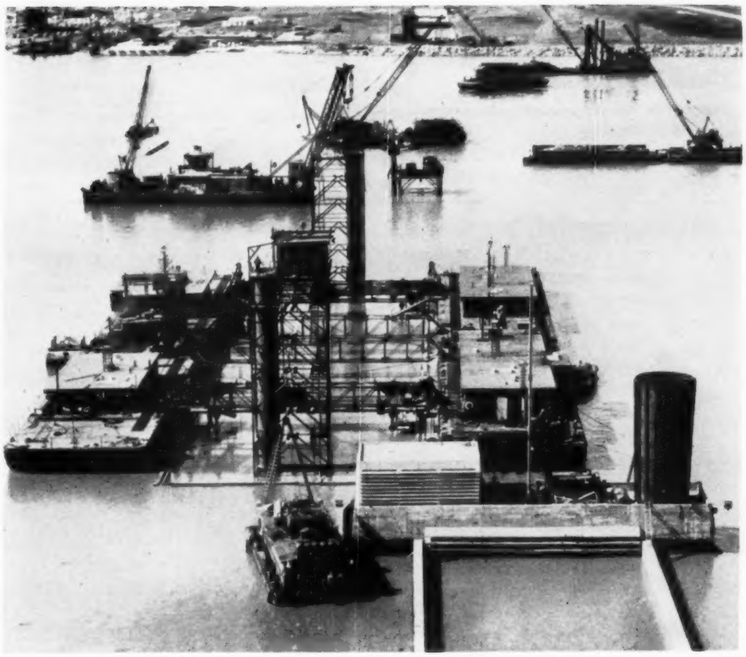


FIG. 1. Deas Island Tunnel will open up new area south of Vancouver and provide direct connection to Trans-Canada Highway and U. S. border.

FIG. 2. Dikes protect open tunnel approaches against floods.

Elements for Deas Island Tunnel are under construction in improvised drydock in foreground. Tunnel line is shown by approaches. Shallow far channel will be crossed by earth fill and a 316-ft three-span bridge.

Final tunnel element, floating between scows, is being positioned for sinking in April 1958. (See Fig. 5.) Note towers on this element for alignment and access. Just to right of far tower is tower on adjacent tunnel element, previously sunk. Above at right riprap is being placed. Mixer barge is at left. Flooded Lulu Island approach is in foreground, with ventilation tower at right.



PER HALL, M. ASCE,
President

D. A. YOUNG,
Assistant to the Vice President

Foundation of Canada Engineering Corporation Limited, Montreal

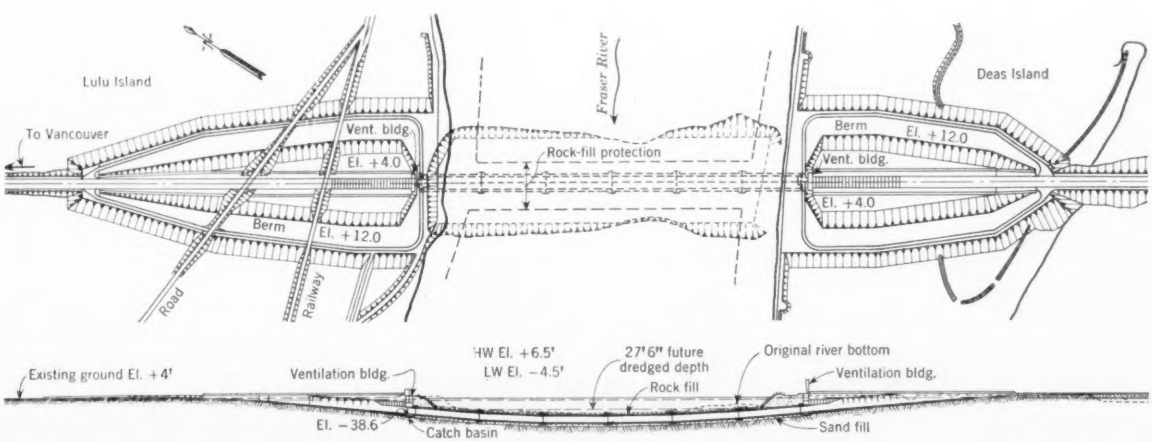
TUNNEL placed by trench method

require vehicles to deviate only 80 ft from the horizontal, as compared to 160 ft for a bridge.

The general arrangement of the tunnel and the system of dikes protecting the approaches against severe floods are shown in Fig. 2. It will be noted that horizontal curves have been avoided and that a maximum grade of 3.5 percent has been observed to facilitate vehicular travel and to make it easier to inspect the tunnel by television.

For the approaches, reinforced concrete trough sections were chosen in preference to fully enclosed sections for economy in ventilation, and in preference to open cuts for economy of construction. Since the permeable soil in this vicinity lies below high-water level and within an earthquake area, the construction of open-cut approaches would have necessitated the installation of extensive cutoff walls and the use of very flat side slopes.

Basic dimensions of the trough sections were determined to give stability against deflections under the worst possible loading conditions and against uplift. See Fig. 3. In the shallow part, simple gravity sections are used. Next, cantilevered slabs extend under the earth to utilize the weight of the backfill in counteracting uplift forces. In the deepest part, concrete struts between the vertical walls eliminate the necessity for uneconomically heavy cantilever walls.



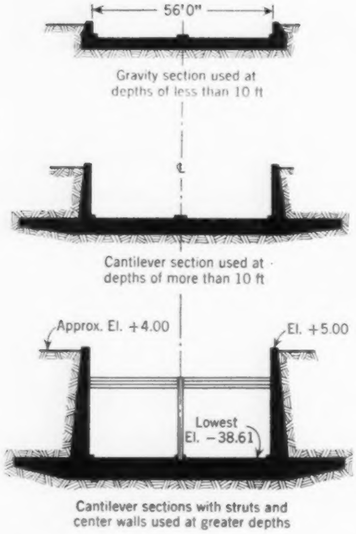


FIG. 3. Reinforced-concrete trough sections for approaches give stability against worst possible loading and against uplift.

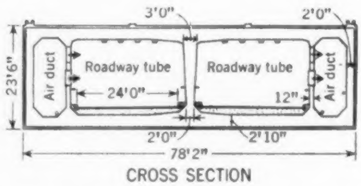


FIG. 4. Uniform cross section was used throughout entire length of tunnel. On each roadway, ventilation air is drawn out of tunnel for first half of the length, then fresh air is forced into the roadway and pushed out of exit by vehicle movement.

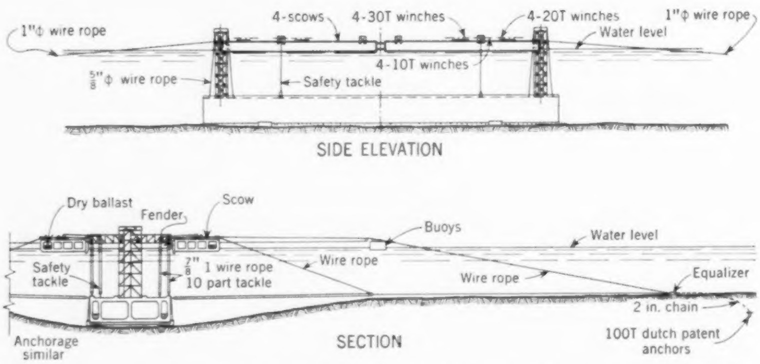


FIG. 5. Two long scows on each side of the 344-ft tunnel element carry rigging for positioning and lowering it.

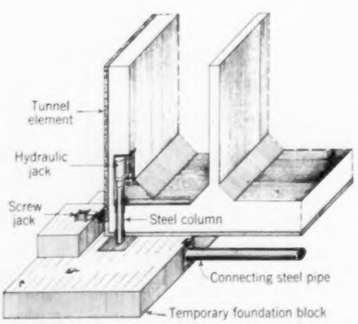


FIG. 6. Final accurate positioning of tunnel elements was accomplished by temporary foundation block and jacking equipment shown.

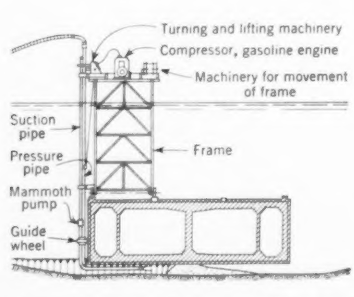


FIG. 7. Space under a seated tunnel element is filled with sand placed by a combination of sand pump and compressed-air jets. Suction pipes also are moved about under the wide element to check for complete compaction and, as necessary, to remove trapped water and draw in sand.

Because the subsoil, of fine sand and silty sand with a few lenses of silt and clay, is so heterogeneous, the approach structures are divided into short units with keys and expansion joints between them to permit of some movement. Theoretical analysis of the effects of an earthquake and the application of ultimate load theory contributed a rational approach to the design.

As has been mentioned, the ventilation buildings are designed not only to house the fans and control equipment but also to act as dams against the river and the earth backfill. To permit of minor movement, the ventilation buildings are made self-supporting, acting as dams founded on slabs. The building walls on the river sides are supported on three external vertical frames which act much the same as the buttresses of a buttress dam although in tension.

The ventilation buildings, like the approaches, were built in the dry in open excavation. The excavation, although very close to the river, was kept dry by a deep steel sheetpile cutoff wall, a secondary earth cofferdam, and an extensive well-point system. With excavation extending to 60 ft below the river level, the well-point and deep-well systems had to pump about 10,000 gpm out of each of the excavations for the approaches and ventilation buildings. Excavation was done by draglines and bulldozers on the north side and by a dredge on the south side.

The subaqueous part of the tunnel consists of six prefabricated elements. A hugh drydock was formed by excavation on shore to below river level to accommodate the construction of these concrete tunnel elements 344 ft long, 78 ft wide and 24 ft high, each weighing about 18,500 tons. An extensive well-point system kept this excavation dry throughout the construction period. The "drydock" was opened, for removal of finished sections, by cutting through the berm separating the basin from the river.

The elements, huge reinforced concrete boxes, were built on the gravel floor of the drydock by conventional methods. To prevent the entry of water into the finished tunnel, the top and sides were coated with a multi-ply asphaltic waterproof membrane and the bottom was covered with ¼-in. steel plate. This was protected on the roof and base by 4 in. of reinforced concrete and on the sides by 4-in. wood planking. For 11 ft at each end of the elements, all waterproofing is of ¼-in steel plate.

The tunnel section, Fig. 4, was designed in accordance with the National Building Code of Canada, using the Hardy Cross moment-distribution method and a limit design principle in respect to earthquake loads. Analysis

proved that a uniform cross section could be used for the entire length of the tunnel and that reinforcing could be the same for all cross sections except for minor variations near the tunnel ends.

Since large sand dunes move along the river bed and layers of compressible soil underlie the tunnel, the structure was analyzed as a beam on an elastic foundation, subjected to a sinusoidal load. The design provides a structure capable of following possible differential settlements without cracking. This was accomplished by designing a shallow section with ventilation ducts flanking the roadway tubes. Such a section has the added advantage over a circular section of permitting a shallower profile and shorter approach structure.

A hydraulic dredge opened a trench along the tunnel line. Previous studies on models, theoretical analyses and full-scale tests had indicated the dimensions and side slopes to which the trench had to conform if injurious silting by the sediment laden water in the river were to be avoided. The dredging was scheduled to proceed just ahead of the placing of tunnel elements to avoid excessive silting, which would require redredging.

Because of the severe conditions prevailing during the spring freshet and because of the significant effects of ocean tides at this location, all six elements had to be placed during the winter. The river flow drops then to 20,000 cfs as contrasted with the flood-period high of as much as 550,000 cfs, both as measured some 60 miles upstream at Hope, B. C.

The placing of an element in the trench, illustrated in Fig. 5, begins with the warping of the floating unit from the drydock to the mouth of the entrance channel, where it is pulled into position between the two pairs of scows and under the supporting trusses that form the sinking rig. Once the element is secured in position, the whole rig is warped to a fitting-out jetty, where final preparations are made for the sinking. At the jetty, temporary foundation blocks are suspended beneath the fifth points of the unit, pump controls, survey stations, control tower and access shafts are installed, and a complete check of ballasting equipment, winch operation and control is run.

When all is in readiness, the sinking rig, cradling the huge concrete element, is warped into position over the trench by cables to anchors working from one end across the river. When close to final location, control valves in the element are opened to allow enough water to enter the ballast chambers to start the descent. As soon as the element begins to sink, supporting cables, arranged to give an effective three-point suspension, take up the 400- to 500-ton load.

By gradually lowering the elements on the cables and trimming by means of the ballast, the unit is sunk into the trench, bearing the slope it will have in its final position. When it is close to the adjoining element and the temporary foundations have touched the gravel pads previously placed and leveled, 1,500 tons of water are pumped in and the cables are released. At this point, the weight of the element is taken up by four hydraulic jacks in contact with the auxiliary foundation blocks. These jacks are arranged to give a statically determinate support to the unit, plus avoiding secondary stresses. The jack and foundation block arrangement is shown in Fig. 6.

The element is left in this temporary position for 24 hours to allow initial settlement of the gravel pads to take place. The following day the extra water ballast is ejected and winches on the placing rig pick up the load again, leaving only some 10 to 15 tons on each jack. Final alignment is accomplished by a cable-and-winch arrangement and by the hydraulic jacks. When the unit is aligned to within 1/8 in. of its final position, and the faces of the joint collars are about 1½ in. apart, a hydraulic hook is engaged with an eye in the adjacent element and the unit is pulled into contact with a force of some 150 tons.

As soon as all final trimming has been accomplished and the slightly inflated gasket is pressed tightly against the face of the concrete collar on the adjacent element, valves in the bulkhead at the joint are opened and the water trapped in the joint chamber is drained off. As the water is removed, the full hydrostatic pressure corresponding to the water depth is brought to bear on the free end of the element and the joint seal is squeezed tightly into positive contact by a force exceeding 3,500 tons.

Once the water is entirely removed, workmen can enter the chamber and complete the joint. To avoid undue stresses, the joint is not actually concreted until all anticipated settlement has occurred.

When the element is seated on the temporary foundation, there is a space of about 3 ft between its base and the bottom of the trench. This space is filled by jetting sand into it by means of the gantry and pipe system shown in Fig. 7. The procedure used packs sand under the unit to form a solid foundation, after which the hydraulic jacks are released so that the load is distributed over the entire foundation.

As work progresses, the trench is backfilled and the tunnel covered with a carefully designed protective layer of sand, gravel, stone and concrete mattresses. These protective works are carried over the whole tunnel and along the river banks in the immediate vicinity to combat the danger of subsequent exposure and undermining of the tunnel structure by river scour. The protection was devised after a series of hydraulic model tests and a theoretical analysis.

The roadway surfacing will be of the bituminous type, laid over the mass concrete, which is placed in the tunnel elements before sinking so that its effect as ballast can be used to advantage during this stage of the construction. In addition it serves as fill and for permanent weighting.

Once the structural part of the project is completed, the electrical and mechanical installations will be made, and by 1959 the tunnel will be open to traffic.

The tunnel incorporates many special features that will make its operation fully automatic, but there will be optional manual control during rush hours. Four 75-hp fans, each serving half of one side of the tunnel, provide adequate ventilation in combination with the air circulation that accompanies the movement of vehicles. The fans, located in the ventilation buildings at each end of the tunnel proper, are controlled by a time clock set to meet traffic conditions. This control can be overridden by carbon monoxide meters, a fire detection system, or by visibility meters, which maintain a constant check on conditions in the tunnel and set up the proper ventilation program in the event of an emergency.

Traffic is controlled by signal lights, illuminated instruction signs, telephones and public address loudspeakers spaced along the roadways. The tunnel attendant has at his disposal a closed-circuit television system with 14 cameras installed along the roadways to provide a convenient means of inspecting conditions in any part of the tunnel.

Interior lighting is provided at all times and exterior lighting in the approaches is available during the night. Sun screens at the tunnel portals and carefully designed lighting, provide a gradual transition in light intensity between daylight and the minimum of 5 ft-candles in the interior.

Construction is being carried out under two separate contracts. The joint venture of Kiewit, Raymond and B. C. Bridge and Dredging constructed the approaches. Tunnel elements were constructed by the joint venture of Narod, Dawson and Hall of Vancouver and are being placed by Kiewit, Raymond, and B. C. Bridge and Dredging.

New lock at Wilson Dam is seen under construction in March 1958. Navigation channel will be cut through the dam above upper sill, and a high-level bridge will replace lock-area roadway along top of dam and bascule bridge which now spans tandem locks at left. Note unique access roadway into work area and mixing plant at lock-floor level.

Lock of 100-ft lift built into Wilson Dam

HENRY T. LOFFT, A.M.ASCE, Chief Construction Engineer

CORYDON W. BELL, Jr., A.M.ASCE, Civil Engineer, Office of the Chief Engineer

Both Tennessee Valley Authority, Knoxville, Tenn.

Tennessee Valley Authority is currently constructing a navigation lock of 100-ft lift which, for a time, will be the world's highest single-lift lock. It is located at Wilson Dam (near Florence, in northwestern Alabama), where in earlier times shoals and rapids severely hampered and occasionally prevented navigation in a reach of the Tennessee River that drops nearly 100 ft in 27 miles. Begun in July 1956, the 110- by 600-ft structure is scheduled for initial operation in April 1959 to augment the existing locks for the same lift. The entire project, including deepening of one of the present lock chambers and related canal changes, will be completed about March 1960. Total project cost is estimated at $35 million.

Rapids long an obstacle

Since pioneer days the major obstacles to navigation on the Tennessee River have been the dangerous rapids at Muscle Shoals and the Elk River shoals upstream, together with the Colbert and Little Muscle Shoals downstream. Completion of Wilson Dam and Lock and Dam No. 1, with the connecting Florence Canal, in 1925-1927, finally corrected the situation but only after a hundred years of almost continuous planning, legislation, and construction difficulties. In 1836, a 14.5-mile canal with 17 locks was opened to traffic around Muscle Shoals. However, poor engineering, lack of maintenance funds, and railroad competition forced its abandonment a year later. Boats could not enter or leave the canal during low water, and hazardous upstream and downstream shoals still remained to be traversed.

During the 15-year period ending in 1890, the U. S. Army constructed two canals with a total length of just over 18 miles and 11 locks bypassing the Elk River and Muscle Shoals. This system, which had a project depth of 5 ft, was operated successfully until replaced by the present facilities.

Indians navigated the Tennessee River many years before DeSoto utilized it during his expedition to the West in 1540. During the 400-odd years that have passed since this first recorded trip, traffic has increased until today some 13 million tons move on the river each year. Amounting to over 2 billion ton-miles last year, river use has jumped 525 percent since 1946. At Wilson Dam alone, the tonnage locked through increased from 452,000 in 1945 to 2,600,000 in 1957. By 1975 traffic is expected to double.

Located on the river's north bank, the present navigation facilities consist of a double-lift lock at the dam, a canal 2¾ miles long below the dam (separated from the main river channel by Patton Island), and a single-lift lock and dam at the lower end of the canal. The double-lift lock has two chambers in tandem with a combined lift of 90 ft; these chambers are separated from the spillway by a 200-ft non-overflow dam section. Dimensions of the upper and lower chambers are 60 by 292 ft and 60 by 300 ft respectively. The lock at the lower end of the canal has a maximum lift of 10 ft; its lock chamber is 60 by 298 ft.

Like the shoals of former years, existing navigation facilities at Wilson Dam constitute the obstacle to modern-type use of the Tennessee River system. These facilities, designed to meet navigation needs as visualized in the 1920's, now present an obstruction to full development of the river. Many tows require from 6 to 12 hours to pass the three locks, about six times the time required to pass the modern locks at Pickwick and Kentucky Dams downstream. At times, the lock capacity is not sufficient for present traffic, much less that expected in years to come.

In 1955, funds were appropriated for design of the new facilities, and in 1956 further appropriations allowed construction to begin.

New lock facilities

To accommodate the new 110- by 600-ft lock chamber in the existing dam structure, eight spillway gates adjacent to the present tandem lock facilities are being removed. The resulting reduction of spillway capacity, from the original 58 gates to 50, is made possible by the combined effect of upstream river regulation (virtually nonexistent when the dam was built) and the installation of additional power units at the dam.

The new lock chamber is entirely downstream from the dam (Fig. 1), to avoid a very costly upstream cofferdam—in over 80 ft of water. The upper sill and gate, a conventional submerged-lift type, rest on the old dam. The lock

walls extend downstream 800 ft, supplemented by a spillway guide wall 635 ft long. To handle the 100-ft total lift, a double-leaf miter gate 117 ft high will be installed at the downstream end.

The 20,000 cfs of water needed to fill the lock chamber is admitted through a 15- by 15-ft culvert extending the length of the chamber in each wall. These two culverts terminate upstream at bellmouth intakes 15 by 23 ft in the dam face; downstream they make a 90-deg turn and discharge into the dam spillway channel. Tainter-type gate valves, at both ends of each culvert, control the flow to and from the ports of the lock-floor lateral system. Final filling can be accelerated by lowering the upper gate to permit spilling into the chamber, while supplementary final emptying will be accomplished through ports under the lower gate. The latter is necessary because the water level in the canal averages 5 ft below the river level at the point of discharge. Filling will take about 12 min., and the full locking cycle an average of 45 min.

Downstream guard walls are conventional. However the upstream guard wall, 555 ft long, will be a floating reinforced concrete boom similar to that in successful use at Kentucky Dam. A high-level bridge will span both the new and the old locks, thus eliminating traffic interruptions on the river and on the dam roadway.

Canal alignment will be altered to provide a better sailing line with respect to the railroad and highway bridges downstream. This involves by-passing the existing downstream canal lock and dam and requires deepening of the present lower tandem lock chamber and the canal by 10 ft.

Construction features

The 46-month construction program, which began in July 1956, is proceeding according to a critically timed schedule which permits a minimum of delay to traffic on the roadway over the dam and virtually no interruption to navigation. The chief operations involved are the construction of the new lock chamber, including existing spillway alterations; excavation for and maintenance of a temporary canal while the existing canal is being deepened; realignment of the canal at the downstream end; erection of a high-level bridge over the new and existing locks; and deepening of the existing lower lock chamber so that the tandem lock can function as an auxiliary unit without the 10 ft of lift now provided at the canal lock.

Very limited space is available for the construction plant. The usual shop, warehouse, and office buildings are located above the old tandem locks on the right bank. A feature is a unique access bridge across the existing locks. The mixing plant, with three 2-cu yd tilting mixers, is situated just downstream from the land wall of the new lock. It is supplied with graded aggregates (from sand to 6-in. cobbles) by conveyor from a 50,000-ton storage area located in a small ravine adjacent to the main construction plant. Cement moves by pneumatic tube some 1,100 ft from a railroad-car unloader to a 4,000-bbl silo. Fly ash is brought in from TVA's nearby Colbert Steam Plant in bulk cement trailers of 125-bbl capacity.

Fly ash brings difficulties as well as savings. With a consistency described by project personnel as that of "dense smoke," this material creates a serious dust problem unless properly handled. Special silo vents and the introduction of the fly ash with the mixing water substantially reduced the dust problem.

Concrete mixes were specially designed and tested to utilize limestone aggregates and fly ash. Manufactured sand and aggregates are furnished under contract. Interior mass concrete (with coarse aggregate of 6-in. maximum size) contains 0.51 bbl of portland cement and 170 lb of fly ash, the fly ash replacing 8.6 percent of the sand and 32 percent of the cement. In the face concrete (with coarse aggregate of 3-in. maximum size), which contains 0.80 bbl of cement and 182 lb of fly ash, the latter replaces 20 and 10 percent of the cement and sand respectively. Full details on TVA's use of fly ash were presented in an article by George K. Leonard, M.ASCE, and Philip A. Schwab, in the March 1958 issue of Civil Engineering.

From the construction-plant area on the bluff to the floor elevation of the new lock, trucks and other heavy equipment must drop 120 ft in a horizontal distance of only 800 ft. To accomplish this, 1,950 lin ft of bridge and roadway are required to permit a suitable

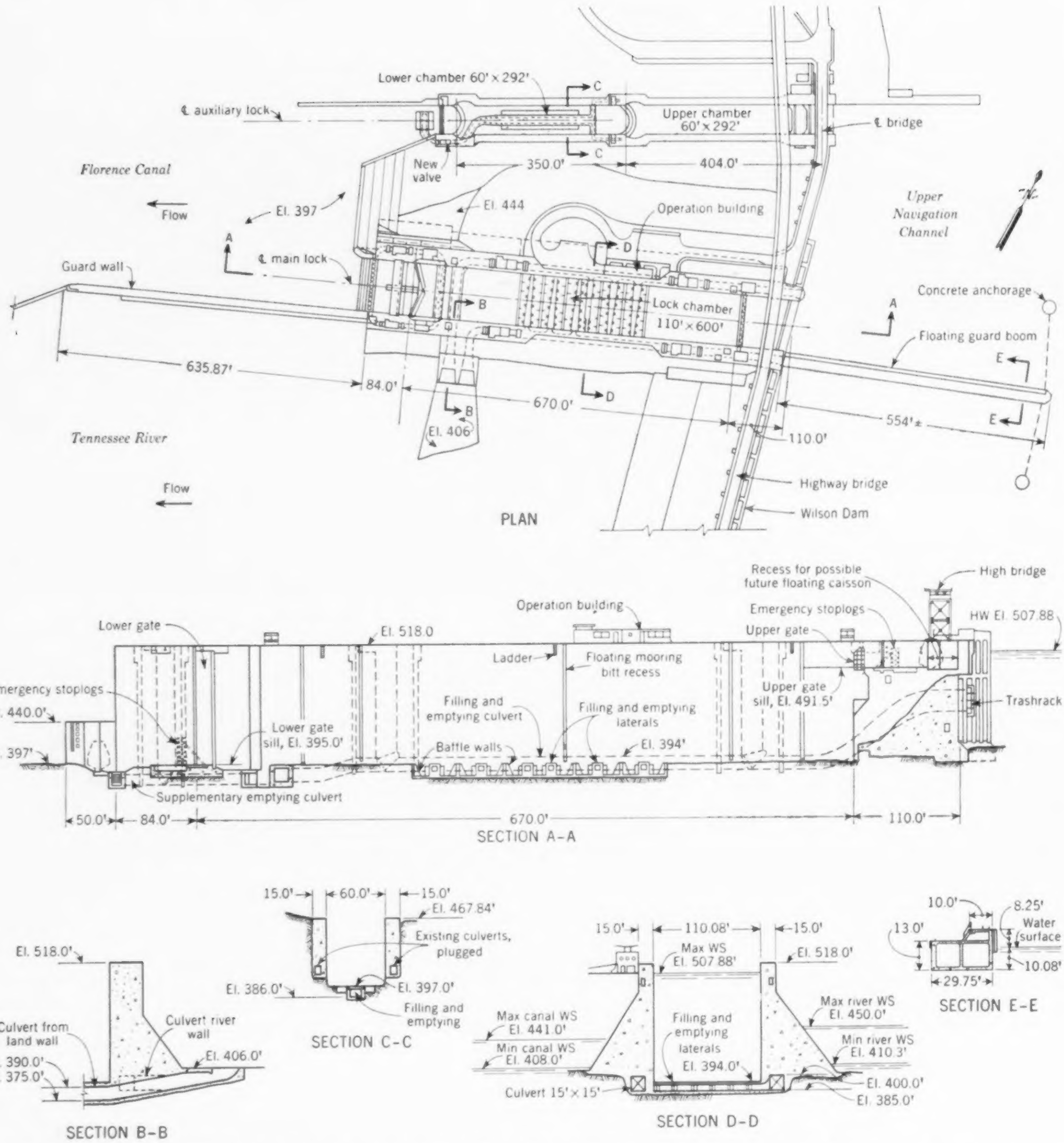


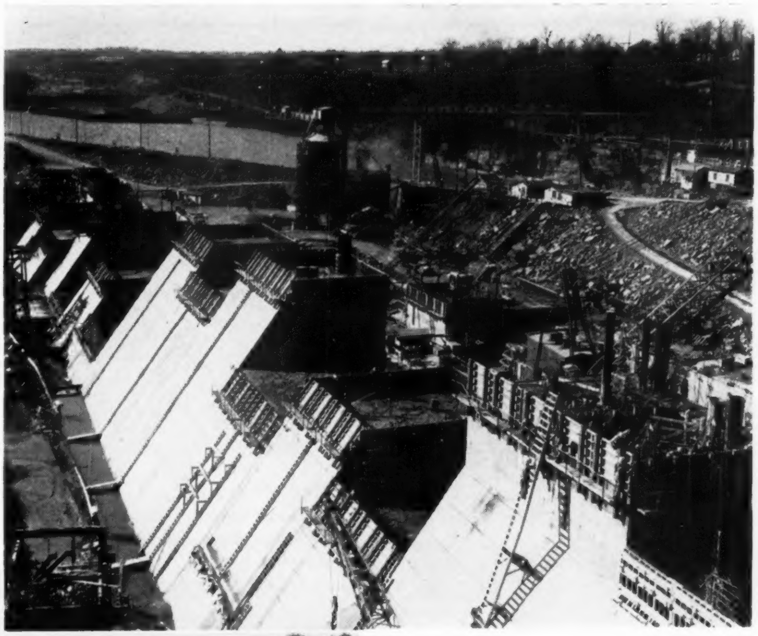
FIG. 1. New lock, 110 by 600 ft, is built into downstream side of Wilson Dam to avoid working in about 90 ft of water in Wilson Lake. Water from this lock of 100-ft lift is discharged into the main stream rather than into navigation channel.

grade. The bridge, a through-truss span, crosses the existing lower lock chamber on a 5-percent grade at an angle of 78 deg, and has a navigation clearance of 52 ft. On the same grade, a timber trestle then makes a 68-deg turn upstream and connects with two steel trusses (almost parallel to the new lock) which descend on a 7-percent slope to a rock-filled crib abutment and roadway. The roadway makes a complete reverse turn and continues downstream on a 5-percent grade into the work area.

Eleven closely timed cofferdam changes are necessary for new lock construction and to permit deepening of the upper canal and the old lock areas. In addition, seven temporary or permanent dikes are required to allow canal deepening, to make canal alignment changes at the downstream end, and to maintain navigation while this work proceeds.

The cofferdam for the main lock was designed as a standard cellular steel sheetpile structure, but difficulty in obtaining sheetpiling necessitated the substitution of a timber rockfilled crib section 200 ft long from the spillway and across the apron of the existing dam. In the remaining section there are 28 sheetpile cells, each 36.6 ft in diameter and about 38 ft high, the cell farthest downstream being tied to the existing concrete guard wall by a sheetpile cutoff wall supported by berms of clay and rock. The gravel-filled cofferdam cells were grouted on the river side and backed up on the lock side by riprap.

Erection of the main cofferdam on ledge rock was complicated by the presence of large limestone slabs, some containing up to 100 cu yd and weighing 200 tons. These had been displaced dur-



Steel cantilever forms in panels 10 ft long are used for 5-ft lifts in lock walls. These forms, manufactured by Blaw-Knox, have removable panels for easy placement of lock-wall armor.

In Stage 2 excavation area, looking northwest from position of new lock's downstream gate, note removal of rock and old guard wall under way in foreground. Beyond, behind Dike B, is deepened Florence Canal. Temporary canal can be seen in left background.

ing high-water discharges and deposited in piles and windrows below the dam. Drilling and blasting were required to reduce these slabs to a size that could be handled by power shovels.

In January and February 1957, the cofferdam safely passed the Wilson Dam flood of record, 372,000 cfs.

When canal deepening is completed, a rock ledge (2,300 ft by 40 ft, and 10 ft high) will remain under the cofferdam separating the new and old lock areas during Stages 2 and 3. It is planned to remove 1,750 ft of this ledge under water. The remaining 550 ft downstream will be removed in the dry inside a sheetpile cofferdam.

Rock excavation for the new lock, totaling about 200,000 cu yd of a shaly limestone, was completed on schedule in eight months, utilizing conventional equipment and carbide-tipped bits. This limestone contains excessive amounts of flint (or chert) which is very hard on drill bits and equipment. Powder requirements ran $\frac{3}{4}$ lb and blast drilling from $1\frac{1}{2}$ to $1\frac{3}{4}$ lin ft per cu yd of excavation. A complete broaching operation was necessary in lines adjacent to the dam to protect the old concrete.

The 15-month concreting operation, during which over 375,000 cu yd will be placed, is approaching completion with 354,000 cu yd placed through June 4, 1958. Concrete is trucked an average of 500 ft from the mixing plant in 4-cu yd buckets. Most of it is placed by a 40-ton electric American revolver gantry crane mounted on lock-floor rails. Other pours are made with 2-cu yd buckets handled by crawler cranes. Placement has averaged 1,800 cu yd per day with 2,100-cu yd peaks while working in big blocks. Concreting is done on the two night shifts, the day shift being reserved for form changes and other construction.

Principal wall sections are formed in 5-ft lifts using Blaw-Knox steel cantilever forms. Removable panels within the forms allow the protective lock-wall armor to be set integrally with the walls. These forms are raised by aluminum A-frames with manual hoists. For special sections, culverts, and vertical recesses, reuseable shop-made wood forms are utilized.

Passage of water through the dam to fill the lock presented a special construction problem. Two passages, one in each

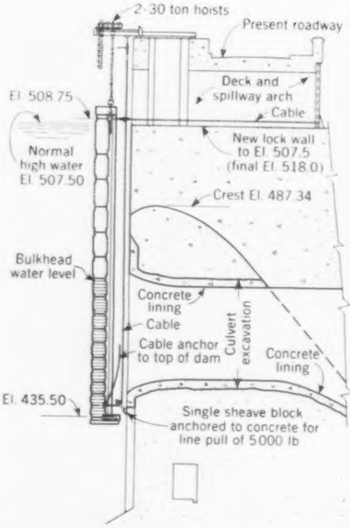


FIG. 2. Floating bulkhead, 46 ft wide and 74 ft high, is positioned against face of dam and unwatered. Tunneling can then proceed through dam for lock-filling culverts. After floating to site, bulkhead was turned into vertical position by flooding of compartments in its base, seen at right in photo above. In photo at left, below, bulkhead is in position. Lines on it indicate finished culvert dimensions.

lock wall to supply the filling culverts, required removal of dam concrete without disturbing the old structure. It was possible to remove part of the concrete by an open shooting procedure on the downstream face. However, stability considerations for the old dam limited this to about 16 ft of the total 42-ft cut.

Before further tunneling could be carried out, it was necessary to place the concrete for the upper gate sill to approximate final elevation and to concrete the lock walls (upstream blocks) to above lake level. The lock walls were built up back of a floating bulkhead regularly used for gate repair. The sill and wall blocks loaded the spillway, in addition to stabilizing the spillway piers against the horizontal pressure of the bulkhead upstream. The tunnel cut, 19 by 27 ft (15 by 23 ft after lining with concrete to facilitate flow), removes about one-fourth of the dam volume in that section.

To seal off the Wilson Reservoir while culvert tunneling and concreting operations are under way, a 200-ton floating bulkhead, 46 by 74 ft, was built of high-strength steel plate. This bulk-

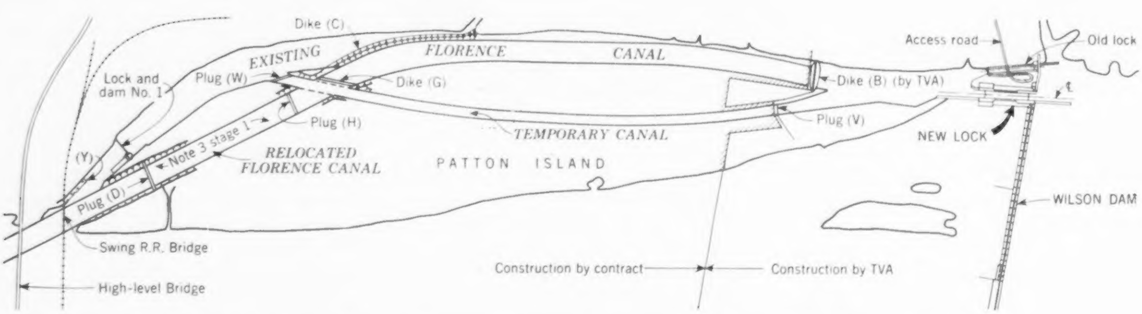


FIG. 3. Closely scheduled channel changes are necessary to avoid navigation stoppage as Florence Canal is deepened to eliminate Lock and Dam No. 1.

STAGE 1. Navigation through existing Florence Canal

(1) Excavate temporary canal between plugs (V) and (W), excavate area at canal intersection (G) and (H) to final grade of permanent channel.

(2) Construct part of dike (C). Do not block navigation.

(3) Excavation in this area started during Stage 1.

(4) Construct dike (G) and leave plug (H).

(5) Remove plugs (V) and (W) and open temporary canal to traffic.

STAGE 2. Navigation through temporary canal

(1) Complete dike (C), unwater existing Florence Canal. Build dike (B).

(2) Leave plug (D).

(3) Excavate existing and relocated Florence Canal.

(4) Place slope protection (Y) and other slope protection.

STAGE 3. Navigation through temporary canal

(1) Remove dike (G) and plug (H) within 1,110 calendar days.

(2) Removal of dike (B) and plug (D) will be done by TVA.

head is a 3-ft-deep, all-welded, cellular structure whose sides and bottom fit against the dam's upstream face. See Fig. 2 and accompanying photo. Because of the rough and irregular surface of the dam concrete it was necessary for a diver, using a series of vertical tightwires, to plot the configuration of the dam face. From this information sealing details were worked out using shaped timbers and rubber seals of music-note type.

The bulkhead was positioned by flooding the three lower compartments, thus turning it to a vertical position. It was then sunk to the right depth in front of the culvert opening and pulled tight by cables. Water was pumped out from behind it to a point just below the spillway crest, as shown in Fig. 2. The spillway gate was then removed and all water pumped out, thus allowing external water pressure to complete the sealing of the bulkhead. A similar procedure will be used at the other culvert entrance.

With the bulkhead in place and unwatered, a carefully planned and executed tunneling program began. Starting from the previously excavated downstream face, three advances of 6 ft and one of 6 to 8 ft were made. The top and bottom were line drilled on 4-in. centers; spacing was 4 to 8 in. at the sides depending on closeness to an adjacent construction joint of the dam. Blast-hole spacing varied from 1½ to 2 ft, the closer spacing being in a pilot-hole area. In the three 6-ft advances the pilot-hole was line drilled and blasted; the face was then pulled by blasting into the hole. About 22 holes were drilled for each round using an average of 170 lb of Hercules Gelamite No. 2 per 6-ft advance with Dupont No. 6 standard-delay electric caps and up to 10 delays. Explosives varied from 1.5 to 14 lb per hole. All loading was strictly supervised and recorded. The average amount of concrete removed for each advance was 110 cu yd.

Before the final 6- to 8-ft advance, the culvert stoplog was positioned to prevent area flooding should the bulkhead become damaged. A timber platform was constructed in the bulkhead to catch falling concrete and a timber mat placed over the culvert entrance area. Line drilling was carried completely through the entire section and the enlarged pilot-hole broached through to the bulkhead void. Blast holes, on 18-in. centers, were drilled to within 18 in. of the dam's upstream face.

Using only ⅝ lb of dynamite per hole—⅜ lb at the front (tunnel face) and ¼ lb at the back of each hole—the section was pulled to the pilot hole. The remaining concrete, already cracked by adjacent excavation, was chipped and wedged out. Closeness of both the bulkhead (inner face was only about 3½ ft away) and the dam construction joint, made removal of the last section particularly critical.

A high-level bridge over the navigation channels will replace the roadway on the dam and the bascule bridge at the present lock. Removal of the present roadway arches and piers in the new lock area is a rather difficult job which will be closely timed and planned for accomplishment during the four-month period when the roadway will be out of service during erection of the high-level bridge. Four existing roadway arches weighing 1,580 tons each and three piers weighing 460 tons each must be cut into 20- to 40-ton chunks, loaded on barges, and disposed of upstream in Wilson Lake.

Just before closing of the present roadway, scheduled for December 1958, 16 ft of the downstream roadway section will be removed across all four arches, reducing traffic to one lane. After the road is closed, the remaining 11½ ft of the roadway section and the 19-ft gate section will be removed, allowing concrete to be placed in the bridge foundations in this area and in the lock walls up to final grade.

Original schemes contemplated the removal of the gate section, roadway arch and piers in the wet, using an air cushion during blasting to protect the dam concrete. However, the TVA Construction Plant Branch developed a method that permits their removal in the dry by utilizing both the permanent spillway and the temporary culvert bulkheads.

Floating guard boom

A floating guard boom, 555 by 27 ft, on the spillway side of the lock, will guide vessels into the upstream entrance. This concrete boom will be built in six sections in an area just downstream from the new lock and floated when the area cofferdam is flooded. The sections will be assembled in the lock chamber and towed into the lake above the dam, perhaps as the first craft locked through. Assembly, by bolting, is facilitated by temporary flooding of compartments to align the boxes.

The downstream end of the floating boom will be fastened to the lock wall. The upstream end, or nose, of the boom must have two anchors to hold it in position in over 80 ft of water. The scheme currently favored is to use 900-ton anchor blocks made as open-ended cylinders 27 ft in diameter and 20 ft high, constructed of steel plate and internally braced. Provision would be made to center a tremie pipe in the cylinder and hold it there while placing some 450 cu yd of concrete under water from a floating plant.

Reconstruction of Florence Canal

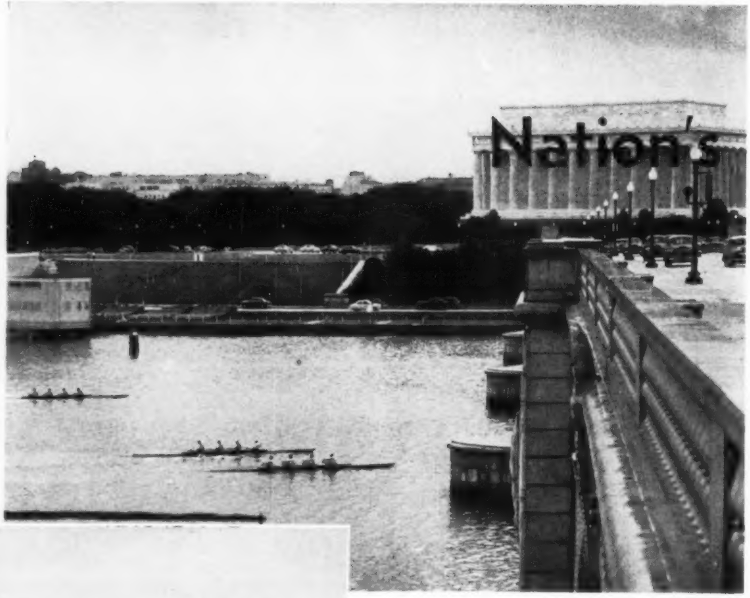
In the Florence Canal and the temporary canal downstream from the lock, the Massman Construction Company and the Farrell Construction Company are moving 3.2 million cu yd of material under a $4,000,000 contract. The temporary canal, 100 ft wide, excavated mostly in the dry, permits navigation to continue without interruption while the contractor deepens the existing 300-ft-wide Florence Canal and relocates the lower end to bypass the canal lock of 10-ft lift. Involved are about 2.0 million cu yd of overburden and 625,000 cu yd of rock. With the exception of 110,000 cu yd of earth, excavation is in the dry. Overburden is piled on Patton Island, raising the present dike that protects the canal from the river, while most of the rock becomes riprap protection for the canal slopes. Two 6-cu yd walking draglines handle most of the overburden. The relocated and the temporary canal are shown in Fig. 3.

Upstream from Dike B, TVA is removing about 270,000 cu yd of rock and 40,000 cu yd of earth in conjunction with the canal deepening. This work is divided into three stages, dictated by lock construction and navigation requirements: Stage 1 is at the Florence Canal entrance, Stage 2 in the area of the new lock, Stage 3 in the tandem lock entrance, including deepening of the lower old lock chamber.

Alterations on old lock

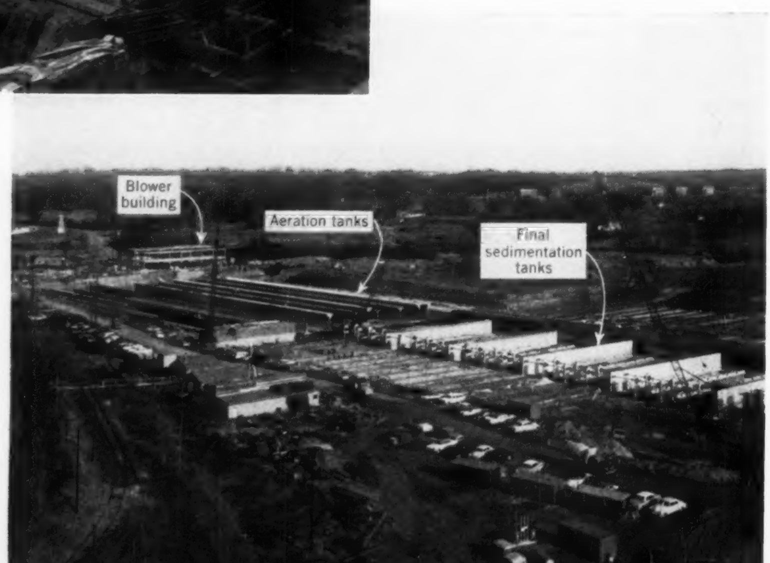
With the new lock and reconstructed Florence Canal in operation, the old tandem lock can be taken out of service and unwatered. Machinery and gates for both locks will be given a general overhaul. Lowering of the downstream lock floor by 10 ft requires an excavation totaling about 21 ft in depth so that a new filling and emptying culvert can be built into the floor. The existing wall culverts will be plugged. Repairs will be made to the downstream wall blocks and, of course, 10 ft must be added to the downstream miter gate.

Design and construction of the new Wilson Lock are under the supervision of the TVA Office of Engineering, of which George K. Leonard, M.ASCE, is Chief Engineer, Robert A. Monroe, M.ASCE, is Chief Design Engineer, Reed A. Elliot, M.ASCE, is Chief Water Control Planning Engineer, and the senior author is Chief Construction Engineer. At the project, Warren McMahan, H. L. Broadfoot, M.ASCE, and J. C. McCraw, A.M.ASCE, are respectively Project Manager, Construction Engineer, and Construction Superintendent.



Program will reduce pollution of Potomac River, thus enhancing its recreational use. Here, as part of President's Cup Regatta, a scull race is in progress. Lincoln Memorial is at right. Photo by National Park Service.

Addition to Washington, D. C., sewage treatment plant will provide high-rate aeration. See close-up at left and general view below. Photo by District of Columbia, Department of Sanitary Engineering.



In close-up of aeration tanks under construction, above, existing sewage treatment plant appears in background. Photo by District of Columbia, Department of Sanitary Engineering.

Part 2. $150-million program includes addition to Treatment Plant

Capital enlarges its sewerage system

C. FRANK JOHNSON, M. ASCE

Engineer-Director for District of Columbia's Board of Engineers, composed of Chairman Frank A. Marston, Samuel A. Greeley and Gustav J. Requardt, all Members ASCE

Senior Engineer, Metcalf & Eddy, Boston, Mass.

The population growth of Washington, D. C., has been phenomenal. From a population of 486,869 in 1930, it jumped to 802,178 in 1950. The present population exceeds 866,000. The estimated population for the year 2000 is 1,125,000. While the population growth of the city itself has recently slowed down to some extent, the suburbs are growing rapidly. The tributary population in the Washington Suburban Sanitary District now is about 500,000 and is expected to increase to 800,000 by the year 2000.

The populations used for design are as follows:

Sewage treatment plant, year 1980	1,791,000
Sewer system, year 2000	1,925,000

The average population density in the District of Columbia for 1950 was 27.3 persons per net (sewage-producing) acre, and for the year 2000 is expected to be 38.3.

Water consumption (filtered water delivered to mains) is shown in Table IV. The present yearly average use by domestic consumers is 55 to 60 gcd (gallons per capita per day). A value of 65 gcd was used for design, allowing for some increase in future years.

The per capita consumption in Washington is considerably greater than that in the suburban area, because the consumption in Washington is for governmental, industrial, commercial, and other uses peculiar to the capital, while that in the suburban area is almost solely for domestic use.

Comparison of data in Table IV with data in Table VIII, keeping in mind the Washington Suburban Sanitary District population tributary to the District of Columbia sewage treatment plant, indicates that the annual average water consumption does not differ greatly from the annual average quantity of sewage. However, a variation was found in the ratio from month to month.

The basis used for estimating average sewage flows for design is given in Table V. Hourly peak rates of dry-weather flow were computed by the use of factors applied to the yearly average total dry-weather flow, ranging from a factor of 2.0 for average flows exceeding 60 mgd (million gal daily), to 3.0 for a flow of 6 mgd, and up to 6.0 for a flow of 0.05 mgd.

Since it is permissible in Washington to drain to separate sewers a limited amount of areaway and depressed driveway, it was necessary to allow for a small amount of stormwater. This was done by adding an allowance to the peak dry-weather flow, ranging from 15,400 gad (gallons per acre per day) for a 10-acre area having a density of 40 persons per acre to 1,480 gad for a 10,000-acre area having a density of 10 persons per acre. Typical peak rates, or required capacities, for design of separate sewers are given in Table VI.

For the design of interceptors, provision was made to take some stormwater from the tributary combined sewers, using dilution factors from 5 to 30, and about 200 in one case, as stated in Part 1 of this article [in the June issue], for the sewers tributary to the various streams. Overflows from the interceptors to the streams were provided at two points where the dilution factor decreases with progress downstream. A minimum design rate of 300 gcd was recommended for separate sewers and interceptors.

The so-called rational method was used for determining stormwater runoff for the design of combined sewers. In general, a 15-year rainfall frequency curve was used, based on 60 years of record at Washington, as shown in Table VII. For areas of over 500 acres, a "distribution coefficient" was used to reduce the estimated runoff, based on a paper by Frank A. Marston, M. ASCE, (*Transactions* of ASCE, 1924, Vol. 87, p. 535).

A coefficient of runoff of 0.30 was used for pervious surfaces and 0.90 for impervious surfaces, for all durations. Typical proportions of present impervious surfaces were determined by measurement of several blocks in Washington, and impervious conditions as of the year 2000 were estimated on the basis of these measurements, using maps showing present development, and considering the zoning regulations.

Sewer capacities

Computations of capacities for sewers were based on a value of Kutter's or Manning's n of 0.015 for all existing sewers and for proposed sewers 24 in. and less in diameter; and an n value of 0.013 for proposed sewers 27 in. and larger. Allowance was made for additional head losses in the case of curves, special structures, and increases

FIG. 4. Typical profile of an existing combined trunk sewer compares actual capacities with those required in year 2000. (Figs. 1, 2, and 3 appeared in Part 1.) ▼

TABLE IV. Water consumption

Period	District of Columbia				Wash. Suburban San. Dist.			
	Annual av.		Maximum day		Annual av.		Maximum day	
	mgd *	gcd †	mgd	gcd	mgd	gcd	mgd	gcd
Max. of record	156	190	233	275	37	79	64	142
Est. for year 2000	236	210	354	315	63	85	..	...

* mgd = million gallons daily
† gcd = gallons per capita per day

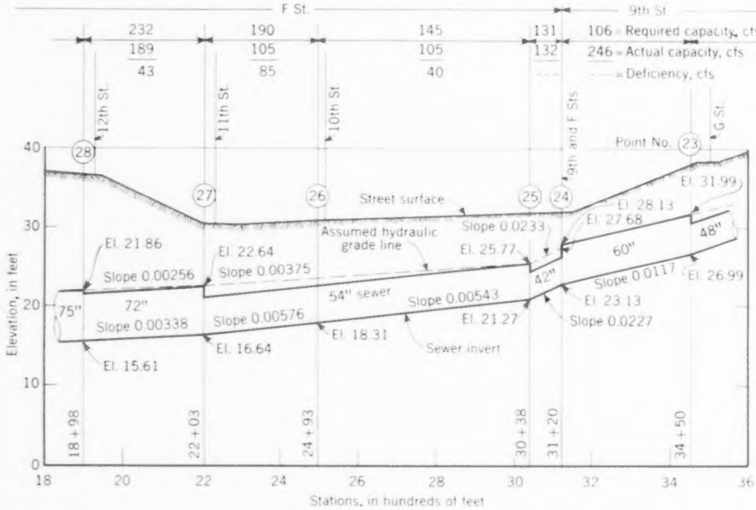


FIG. 5. High-rate aeration plant is being built as addition to existing sewage treatment plant.

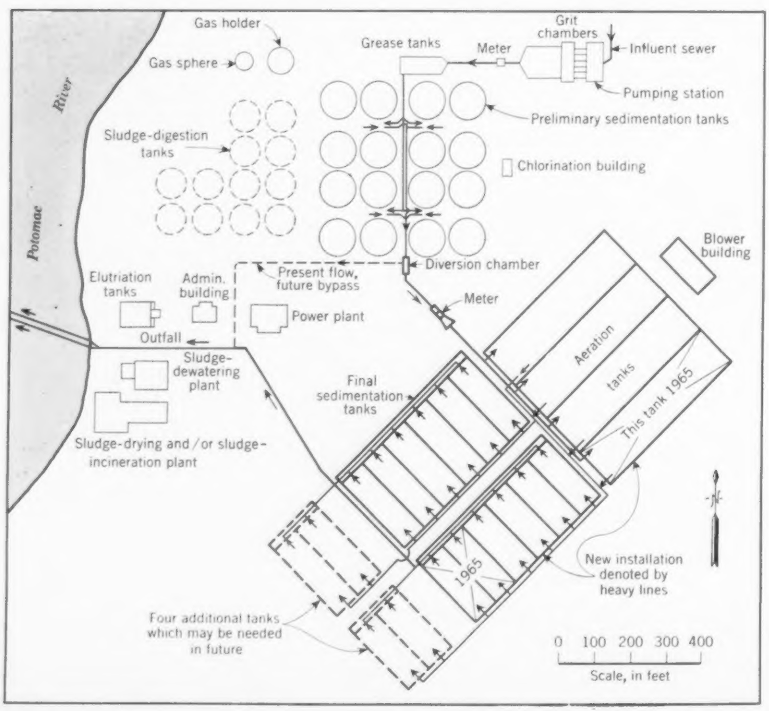


TABLE V. Estimated yearly average dry-weather flows for year 2000

Description	Dist. of Columbia	Wash. Sub. San. Dist.
Domestic sewage, gcd †	65	65
Commercial and industrial wastes from neighborhood areas, gcd	15	20*
Sewage from other commercial and industrial areas, and from governmental and municipal sources	Special consideration for each case	Included in 20 gcd above
Groundwater infiltration, gad †	700	400

* Includes also sewage from all commercial, industrial, municipal, and governmental sources.
† gcd = gal per capita per day; gad = gal per acre per day.

TABLE VI. Hourly peak rates

For design of separate sewers serving residential areas, in gal per capita per day (gcd)

Area, acres	No. of Persons per Acre				
10	1,760	1,230	1,070	970	884
100	1,453	991	822	740	656
1,000	984	670	563	500	446
10,000	546	376	313	280*	251*

* 300 gcd used as a minimum actual design rate.

TABLE VII. Rate of rainfall adopted as basis for design of combined sewers

Duration, min	Rate, in. per hr	Duration, min	Rate, in. per hr
5	7.56	60	2.66
10	6.30	80	2.22
15	5.44	100	1.92
20	4.81	120	1.70
30	3.95	150	1.46
45	3.16	180	1.29

TABLE VIII. Sewage quantities at treatment plant, mgd

Period, Fiscal Year	Annual Av.	Av. of 5 Summer Months	Max. Month	Max. Day
1955	159	176	186	210
1956	162	182	218	255
1980, est.	240	266	290	348
2000, est.	289	..	..	..

in velocity. Possible recovery of velocity head when the velocity decreases was generally ignored.

For proposed separate sewers and interceptors, a minimum velocity of 2.0 ft per sec was used when the sewer is filled or half filled, based on the value of n being 0.013. A minimum slope of 0.0005 was used where practicable. For proposed combined sewers, a minimum velocity of 3.0 ft per sec was used, when filled or half filled. In general, the inlet time was taken as 10 min.

Studies were made of the required and actual capacities of the existing combined and separate trunk sewers and interceptors. It was found that most of the combined trunk sewers were quite inadequate, which was not surprising since they were built long ago, before present design standards and methods were devised and before the recent phenomenal growth of the city could be anticipated. Most of the separate trunk sewers, on the other hand, were found to be adequate, except where large Maryland areas are to be served or where excessive storm-water causes surcharging. Most of the intercepting-sewer system was found to need relief.

A part of a typical existing combined trunk sewer and the corresponding required and actual capacities, as developed by the study, are shown in Fig. 4. This profile illustrates the method used many years ago of matching sewer inverts rather than crowns, which results in a lower actual capacity than is indicated by the invert slopes.

Relief sewers were planned for the combined trunk sewers after a study of the hydraulic computations and the records of sewer and street floodings. Relief sewers were planned for the separate trunk sewers and interceptors where the computed deficiency was material. Proposed relief sewers are shown in Fig. 2, in Part 1 of this article [in the June issue].

Sewage treatment plant

Sewage quantities at the treatment plant are shown in Table VIII, and sewage characteristics in Table IX. The treatment plant now removes somewhat more than half the suspended solids in the raw sewage and somewhat less than one-third of the organic matter as measured by the 5-day B.O.D. This treatment was deemed inadequate, although it was concluded that the Potomac would in the future satisfactorily assimilate polluting matter having a total B.O.D. of 120,000 lb per day.

The "high-rate aeration plant" (Fig. 5), which was put under construction recently as an addition to the treatment plant, was planned and designed prior to the Board's study. It will enable the entire treatment plant to remove over 80 percent of the suspended solids in the raw sewage and about 80 percent of the B.O.D., under 1980 conditions. The design is such that operation can be changed from high-rate aeration to step aeration, if ever desired, by making certain alterations in, and additions to, the structures. Such a change would increase the degree of treatment over 10 percent.

The Board concluded that the planned addition to the sewage treatment plant was necessary to obtain the desired abatement of pollution. It was thought that 16 final sedimentation tanks may be desirable in the future, rather than 12 as originally contemplated. Certain other improvements were recommended for the treatment plant, including increased pumping and metering facilities, reconstructed grit chambers, new sludge-thickening tanks, additional elutriation tanks, and additional vacuum filters. Their design has already been started. The improvements were planned for construction in three stages, extending to 1970. The total estimated cost is $18,000,000.

The recommended work at the treatment plant will help reduce the pollution to acceptable conditions. The study shows that, after completion of all the recommended work, including relief intercepting sewers, the average dissolved oxygen in the Potomac in any month will not be below 5 ppm, and that in not more than about three months in any five-year period will the minimum dissolved oxygen be below 3 ppm.

As aptly stated by a District of Columbia official, this program provides a degree of protection to the river beyond normal sanitary or esthetic requirements. Although these standards are higher than those generally met in the past by the average city, they are considered justifiable in the nation's capital.

The District of Columbia was represented in the work by its Department of Sanitary Engineering, of which David V. Auld, M. ASCE., is Director, and Roy L. Orndorff, M. ASCE, Deputy Director.

The study was made by, and under the supervision of, the three members of the Board of Engineers, Frank A. Marston, Samuel A. Greeley, and Gustav J. Requardt, Members ASCE, acting jointly. They were assisted by the engineering firms of which they are partners, respectively: Metcalf & Eddy, Boston; Greeley and Hansen, Chicago; Whitman, Requardt and Associates, Baltimore. In addition, each of the firms did other work, separately, which was helpful to the Board of Engineers and which contributed to the whole improvement program. The writer was in immediate charge of the Washington office of the Board of Engineers.

TABLE IX. Sewage characteristics

Period	Suspended Solids				B.O.D.			
	Annual av.		Maximum month		Annual av.		Maximum month	
	Total, ppm	Lb per cap. per day	Total, ppm	Lb per cap. per day	Total, ppm	Lb per cap. per day	Total, ppm	Lb per cap. per day
Recent years*	164	0.251	142	0.304	142	0.207	108	0.209
1980†	179	0.239	198	0.320	168	0.224	147	0.237

* 1946-1956 for totals, and 1951-1955 for pounds per capita per day.
† Including a substantial allowance for increased amounts of ground garbage.

RECOMMENDED PROGRAM

Pollution abatement:		
Reliefs for interceptors	$60,460,000	
Conversion of some combined systems to separate systems	11,284,000	
Sewage treatment plant	18,017,000	
Subtotal		$89,761,000
Trunk-sewer relief:		
Combined sewers	$57,190,000	
Separate sewers	4,240,000	
Subtotal		61,430,000
Grand total		$151,191,000

IMPACT OF MODERN EQUIPMENT

E. A. BRAKER, General Supervisor of Sales Engineering, Construction Equipment Division,

Mechanization of irrigation and drainage construction is so new that its benefits to our growing nation lie hidden in the problems of surplus crop production. We still look back to gangs of low-paid men digging ditches by slow spadefuls, or to sweating muleskinners leveling land with purple language and little dragfuls.

While the new machines are costly, they have made earthmoving into construction's biggest bargain. In Fig. 1, prepared by the Bureau of Public Roads, the effect of improved equipment on highway excavation bid prices is shown. For irrigation and drainage the effect should be similar. The solid line plots the trend in actual average bids per cubic yard, the higher broken line the theoretical trend if there had been no improvement in equipment or labor productivity since 1923. In other words, the broken line contains the increase in wage rates per hour which has brought higher living standards to construction workers.

The solid line, on the other hand, reflects the expanding use of crawler tractors and internal combustion engines in the twenties, the advent of diesel-powered tractors in 1931, and of self-propelled rubber tired earthmovers in 1938. It further shows that increased power, capacity, speed and ease of handling of all types of earthmoving equipment since World War II have kept costs per yard of earth down, despite longer hauls, depreciation in the dollar, and rapidly rising equipment prices and labor wage rates.

The big earthmoving machines are owned largely by contractors with construction know-how. American farmers, however, still move the most earth. Figure 2, from Department of Agriculture data, shows how the number of farm tractors, larger than garden size, has increased since 1910 and how muscle power is rapidly disappearing from the farm. With 4.6 million tractors capable of developing about 100 million belt horsepower, American farmers in 1957 had become directors of power rather than its sources.

New machines having the greatest impact on irrigation and drainage construction come under the following general classifications:

1. Crawler tractors and matching equipment
2. Self-propelled rubber-tired wheeled equipment
3. Digging, hoisting and loading machines
4. Farm operating and special-duty equipment

First come the crawler tractors, the most versatile and consistent performers in the construction industry. Compact design with all the weight distributed over the driving tracks, together with the ability to pivot turn, enable crawlers to go practically anywhere. They are ideal for heavy pulls such as for subsoil plows and rippers, and make highly maneuverable mountings for pusher plates, bulldozers, bullgraders, front-end loaders, sidebooms and cranes. In addition, they are rugged mobile power units for pumps, hoists, winches and air compressors.

Crawlers come in a wide variety of sizes weighing from 3,500 to over 60,000 lb. All except the smallest sizes are powered by diesel engines. Agility of smaller models; their over-all ease of transportation, operation and maintenance; and their lower prices, often offset the theoretical advantage of the biggest machines on all but the largest projects.

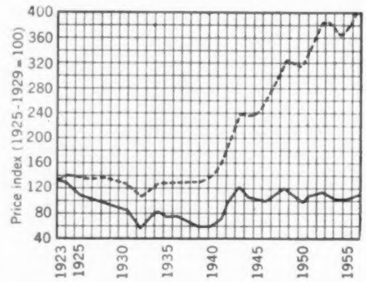


FIG. 1. Effect of improved equipment on construction prices for excavation is shown by curves of Bureau of Public Roads. Solid line plots trend in actual average bids per cubic yard. Broken line shows theoretical trend with no improvement in equipment or productivity.

Trencher with contour ditching attachment opens up canal through level land.

A bull-clam, skid-shovel works as bulldozer, loader and utility machine.

ON IRRIGATION AND DRAINAGE

International Harvester Co., Melrose Park, Ill.

In land forming, self-propelled scrapers are favored equipment for long hauls and also for short hauls when ground conditions permit self-loading, as these two 14-cu yd Payscrapers are doing in Nebraska.

The great handicap of the track-type tractor is its relatively slow speed, about 8 miles an hour at best. Another disadvantage is that its pullbracing steel grouser tracks tear up roadways and finished surfaces. Standard practice is to use trucks and trailers for movement between jobs.

Rubber-tired earthmovers

Self-propelled rubber-tired machines have big advantages over tracks in speed and mobility on firm surfaces including paved roads. Consequently they are in growing use for long-haul earthmoving, rock hauling, dam building, precision finishing of roads, ditches and terraces, and for stockpiling and loading loose materials. Limitations come in traction and flotation on soft, rutted and muddy surfaces. Average traveling speeds are reduced by acceleration time, slippage and waiting for loading or pushing units.

Rubber-tired earthmovers come in a variety of types:

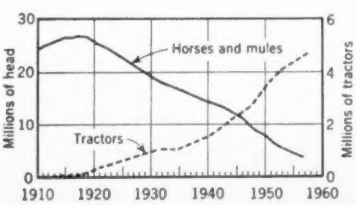
1. **Independent units**
   Four-wheel tractors, all-wheel drive
   Four-wheel scrapers, twin-engine drive
   Motor graders with single, tandem or all-wheel drive
   Shovel-type loaders with front, rear or all-wheel drive
2. **Pusher loaded units**
   Two-wheel tractors and two-wheel scrapers
   Four-wheel tractors, rear-wheel drive, with scrapers
3. **Shovel or belt loaded units**
   Two- or four-wheel tractors with wagons
   Off-highway on-back haulers

Obviously most heavy rubber-tired earthmoving equipment requires auxiliary machines for successful use. To permit maximum hauling speed, haul-road maintenance by motor-graders is desirable.

The larger earthmoving machines generally are available with hydraulic torque converter drive which reduces shock loading on the drive train and makes possible a power-shift transmission. The main drawbacks to greater use of torque converters are initial high cost and the considerable amount of engine power absorbed by the converter, which must be dissipated as heat through the engine cooling system and paid for in extra fuel. This is often more than offset by greater rimpull at slow traveling speed, faster acceleration, and higher speeds on hauls with variable grades.

Digging, hoisting and loading machines

Among the digging, hoisting and loading machines, the most versatile is the power shovel, often a key loading machine for off-highway haulers. Popular sizes range from $\frac{3}{8}$ to 4 cu yd. Nearly all sizes are convertible from shovel to backhoe to dragline, clamshell or crane. The smaller models may be truck-mounted for quick movement



▲ FIG. 2. Relative numbers of horses and mules on farms as compared to tractors (not including garden tractors) are plotted by U. S. Department of Agriculture's Research Service.

In typical Florida land reclamation scene, dragline constructs drainage ditches in background and crawler-dozer levels in foreground.

Portable rotary rigs like this often drill irrigation wells 300 to 400 ft deep in one day. Scene is in Nebraska.

from job to job, or track-mounted for best flotation on soft ground. Multi-purpose units that imitate the human arm and hand are available and extremely useful in cleaning ditches, digging footings and trenches, placing pipe, dressing slopes, backfilling, scooping and loading materials in close quarters.

Belt loaders, powered by an independent engine and pulled by larger crawler tractors, are used under suitable conditions to dig and elevate earth at the rate of 800 to 1,500 cu yd per hr into a stream of rubber-tired haulers, usually tractors with bottom-dump wagons.

Rubber-tired shovel-type loaders have already been mentioned. Similar loaders on modified crawler tractors, in capacities from ½ to 4 cu yd, are also in wide use for digging and loading. A new four-in-one bucket with hydraulic pry-out and roll-back action converts into a skid-shovel, clamshell, bulldozer or a bull-clam shovel, all by touch of a single hydraulic control lever.

Backhoes may be added to either rubber-tired or small crawler loaders to increase versatility for irrigation and drainage construction. Grubber blades, rock forks and grapples are applied to crawler loaders in place of buckets for land clearing.

Trenchers or ditchers make fast, easy work of what only a short time ago was one of the worst backbreaking jobs. Some ditchers have tile-laying attachments. Portable air compressors operate a variety of hand-held diggers, rock and concrete breakers, concrete vibrators, and form-pin drivers. Tractor-compressor combinations are available on which drills, winches, backhoes, and shovel-type loaders can be mounted.

Farm operating and special-duty equipment

Farm operating equipment today is hitched to mechanical power. The principal workhorse is the tractor. More than 4.4 million wheeled tractors of over garden size, together with about 170,000 crawlers, provided mechanization for American farms in 1957.

A typical manufacturer's wheeled-tractor line consists of many models of both 4-wheel standard or utility, and tricycle or Farmall type, with choice of gasoline, liquified petroleum gas, or diesel engines. Power steering, independent rear power take-off, torque amplifier, speed-change on-the-go, fast-hitch and other features enable users to do more in shorter time with less effort.

Of particular interest for irrigation and drainage construction are the utility tractors, which can be used with special-duty equipment combinations such as backhoe and front-end loader; backhoe and angle-blade dozer; front loader and rear scoop or blade; and boom-type trencher and backfiller blade.

Pumps, terracers, concrete mixers, post-hole diggers and drivers can be mounted, as well as erosion and drainage control implements such as two-way disk and moldboard plows, harrows, subsoilers, listers and middle-busters.

Modified utility tractors with only two wheels provide power for small highly maneuverable self-propelled scrapers. They also drive very efficient compactors having combination rubber-tired and steel rollers.

While crawler tractors stand out as favorites of the construction industry, they made up only about 3.7 percent of the tractors on U.S. farms in 1957. Most of these were in smaller sizes. Many have hydraulically actuated toolbar dozer combinations applicable to a wide variety of crop production, soil conservation, irrigation, and drainage operations. Crawler tractors are expected to increase in number as farms are combined into larger units and as soil conservation, irrigation and drainage construction become more urgent.

Sprinkler irrigation is rapidly becoming a part of farm operating equipment in many areas. A typical system includes lightweight portable pipe and fittings, quick attachable couplers, revolving sprinklers selected and spaced to suit soil requirements, and a pumping plant often powered by the same basic engine as in farmer's tractors and trucks. While sprinkler irrigation does not require level land or special soil preparation, an adequate source of water is of course essential. Gated pipe is gaining favor over ditches to conserve water in surface irrigation. Many farmers also use underground pipe for this purpose.

New irrigation techniques

Modern equipment for irrigation and drainage construction has had an impact on construction techniques.

Clearing trees, stumps, and stones is the first big and often spectacular job faced in preparing new land for drainage or irrigation. Crawler tractors do this work at favorable cost per acre. They may be equipped with dozers, stumpers, rock forks, grubber and land clearing blades and other special mounted equipment, some developed by ingenious contractors. Big crawlers also team in pairs to knock down an acre or more of trees per hour, dragging a heavy anchor chain between them.

Bulldozers, bullgraders and skid-shovels dig drainage ditches, fill gullies and build dikes and levees. Three or more big crawlers often team to pull giant plows cutting furrows 3 to 6 ft deep, turning under sand, gravel and mud deposits from floods. Draglines, backhoes and trenchers economically dig drainage canals and tiling ditches with minimum labor.

Fields must be smoothed to a gentle grade for efficient irrigation and drainage. Dozers do the rough leveling by moving large amounts of earth at low cost for distances up to 300 ft. Crawlers and self-loading scrapers then take over to smooth the land closely to grade, hauling earth up to 1,000 ft. If hauling distances are longer, self-propelled scrapers generally do the entire job. Experienced operators taking light cuts with two-wheeled tractors and Pay-scrapers often self-load, thereby avoiding the extra cost of a pusher-crawler.

Leveling on sloping land is accomplished with the same equipment, but by parallel stepped-up benches instead of all on one plane. Finish leveling to 0.1 ft in 100 ft is usually specified for surface irrigation. This can sometimes be accomplished by skilled operators with tractors and scrapers. Normally, however, finishing is done with about three passes of a land plane or automatic land leveler pulled by a crawler or large-wheeled tractor.

The final operation in land forming may be deep subsoiling with rear-mounted crawler-drawn teeth that go down as much as 30 in. This breaks up hardpan for drainage and loosens soil compacted by heavy earth-moving equipment.

Water control and conservation

In the field of water conservation, a Department of Agriculture watershed program requires enormous amounts of equipment and technical know-how. This program involves 1,118,000 farm ponds alone, which can readily be constructed with dozers, scrapers and compactors. It includes terraces long enough to stretch for 75 round trips to the moon. Terraces, of course, can be built at low cost with motor graders, crawler-dozers or with farm tractors and suitable plows.

For flood-retarding structures, more than 4½ billion cu yd of earth must be moved. The average construction fleet for one such typical structure may include two crawler-dozers, three scrapers, a motor grader, an air compressor, a heavy-duty harrow and a compaction roller. It is estimated that earth-moving units for the small watershed program will outnumber those for the National Highway Program.

The equipment, the contractors, and the engineering know-how are available to reclaim, conserve and greatly improve the productivity of the land. Land owners must be strongly encouraged to make full use of all three.

(Mr. Braker's original paper was presented at the ASCE Chicago Convention, before the Irrigation and Drainage Division session presided over by M. C. Boyer, M.ASCE)

▲ Sprinkler irrigation on lettuce land reduces water requirement to one-half that for surface irrigation.

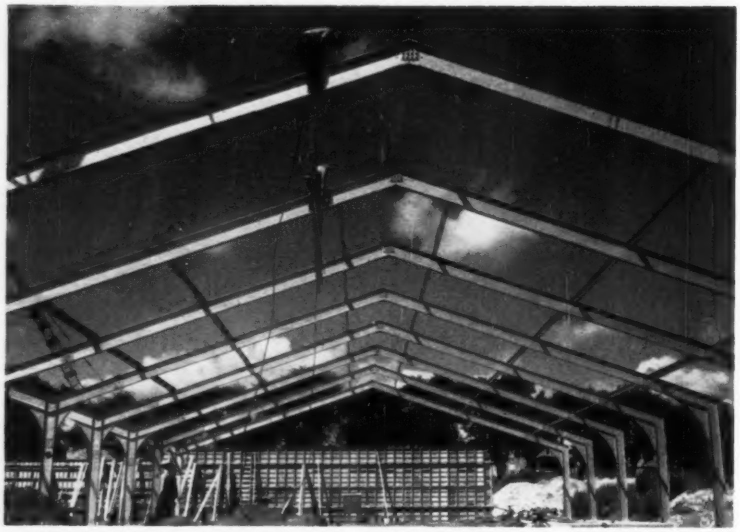
◄ Common open-ditch surface irrigation system requires not only level land but also extra water for seepage losses. Small siphons take water for each row.

Land planer levels large area in preparation for surface irrigation.

Terraces are under construction with a motor grader.

Buy a whole

MAURICE SCHULZINGER,



▲ Structural framing of 80-ft span goes up for a Chicago warehouse.

In this rigid-frame building, roof insulation is rolled over purlins in one piece from eave to eave.

One man can handle one-piece wall sheet. It is crimped at top and bottom to make building weather-tight and vermin proof.

Standardized steel building units can be used in conjunction with concrete-block walls.

Is the selection of a predesigned steel building a mark of progress or a stop-gap measure to fill an emergency requirement? This question often has been raised by engineers and management when confronted with a problem requiring a decision on the type of building to use on a project.

Every structural engineer is taught strength of materials and how to compute the properties of structural sections. The determination of load magnitude is made in one form or another for every project put on paper. But in the search for time-saving methods many of the basic procedures of design, once mastered, must remain unused. Engineers have learned to rely on manufacturers' catalogues for data on available sections and their structural properties.

Such catalogues require many years of preparation and countless engineering hours of work in their compilation. No engineer today questions the section modulus, area, or weight of a rolled beam as stated in a handbook. And very few, if any, question the stated structural values of long-span joists, bar joists or roof deck.

Most young graduates no doubt remember being required to prepare stress diagrams for long-span joists offered by a manufacturer and making a check of each member for size, l/r ratios, and reactions, amount of weld at each joint, and other considerations. Not many offices in this country can afford to have their engineers do this today.

Many engineers may also remember laboriously searching through a steel manual for economical angle combinations to satisfy a stress requirement. Usually the next largest angle size was selected in order to get on with the task of finishing the design. That next larger size may have been 30 percent greater than required, but considerations of economy of material were probably cast aside so as to save the designer valuable time.

building, save design time

Vice President, Engineering, The Steelcraft Manufacturing Co., Cincinnati, Ohio

To make economic considerations realistic, standardization of any steel building components long ago became mandatory. Today professional engineers have learned to rely on the integrity of the engineers employed by manufacturers and to accept the data and products presented.

This mutual respect has been vitally necessary to permit technical work on the design of a project to be completed at a reasonable cost. Without it the number of engineers and architects required to complete a project of any size would be staggeringly larger than it is today. When we come to the question of standardized complete steel buildings, the problems of a manufacturer who offers them to engineers or architects are very similar to those of the early days of the bar joist, long-span joist, and roof deck.

Many busy engineering firms have found standardized buildings a great boon for various types of projects since this type of building enables them to obtain the cost of the proposed project quickly and accurately, frees their staffs from laborious routine structural tasks, and enables them to concentrate their talents on overall selection of material, planning, and the manifold complicated tasks inherent in any industrial or commercial building project. These firms have been able to undertake and execute projects in a fraction of the time formerly required for projects of similar size. Their overall profits as a company have also been greater since most projects are designed on a percentage-of-cost basis.

Many engineering firms, however, are hesitant about accepting such buildings. Much of this feeling may be due to a belief that offering a complete building is an intrusion into their field.

Manufacturers of standardized buildings, however, believe they are adding to the talents of the professional by offering more efficient tools with which to work, more quickly and certainly more economically. Manufacturers further believe that with the constant steady rise in cost of material, particularly steel, a careful selection of the lightest member which will withstand the imposed stresses is a mandatory economic procedure for any designer.

Years of study by manufacturers of bar joists, for instance, has brought them to a stage where all manufacturers provide units that are designed to carry the exact load stated in the tables, and the weights of the joists furnished by different manufacturers will vary by only a trifling percentage. The joist is truly a balanced design and everyone benefits from its selection as a structural member—the client, who does not have to pay for more than he needs; the manufacturer, who knows what his costs will be since he has made the same member so often.

Similarly, manufacturers of standardized buildings who have in recent years developed economical techniques in the design and manufacture of building frames and components have expended the engineering effort to develop buildings of balanced design. Members have been proportioned for maximum economy. Where uniform cross-sectioned rolled structural members are not economical, special wedge shapes are welded together in automatic machines designed for the purpose. Pressed steel sections are used where rolled structural sections are heavier than required to support the imposed load. Special fastening systems have been designed to lower the cost of field erection.

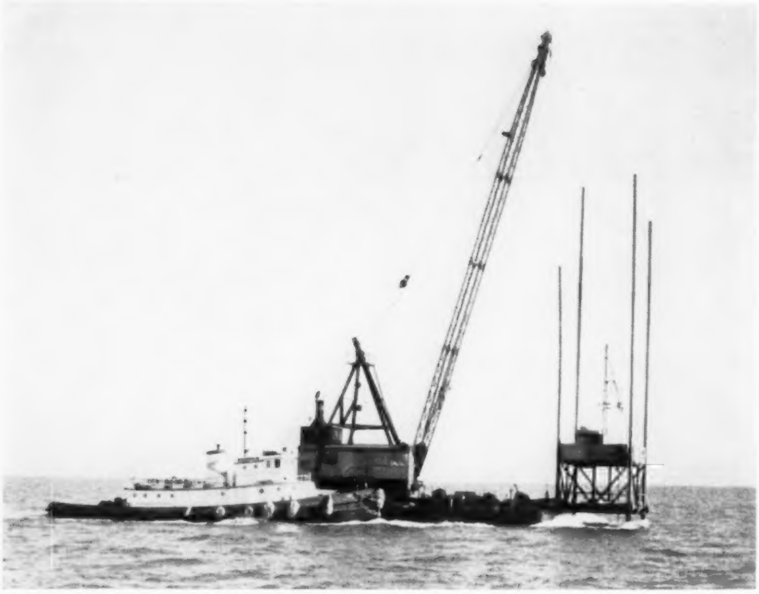
Simplicity of assembly is one of the main features of standardized buildings. This feature, combined with similarity of details in the various spans, tends to stabilize cost of erection and thereby to lower the completed cost. All field attachments are made with bolts and sheet-metal screws, and many parts are interchangeable from one type and size of building to another.

All these measures and many others used to reduce the cost of a square foot of coverage can only be possible when the volume of such work is sufficiently uniform or standardized to pay for the countless hours of engineering required to develop the most economical cross-section to resist the forces imposed upon it, and to pay for the expensive special machinery needed to produce the desired shapes.

The ingenuity of engineers in finding more economical ways to solve a problem is always amazing. There are many such ideas rattling around in every office in the country. The reason many of them fail to see the light of day is because no one wants to put up the money to try them out on a sufficiently broad scale to prove their economic worth.

No engineer feels that he has been untrue to his code of ethical practice if he selects a long span from a catalogue, whose structural properties have been computed by another engineer, and uses it to solve his particular problem. He should feel just as confident in selecting a building system from the catalogue of a reputable manufacturer when that catalogue lists the live load, wind load, span, height, structural-system materials, covering and other pertinent details, all carefully determined by other competent engineers.

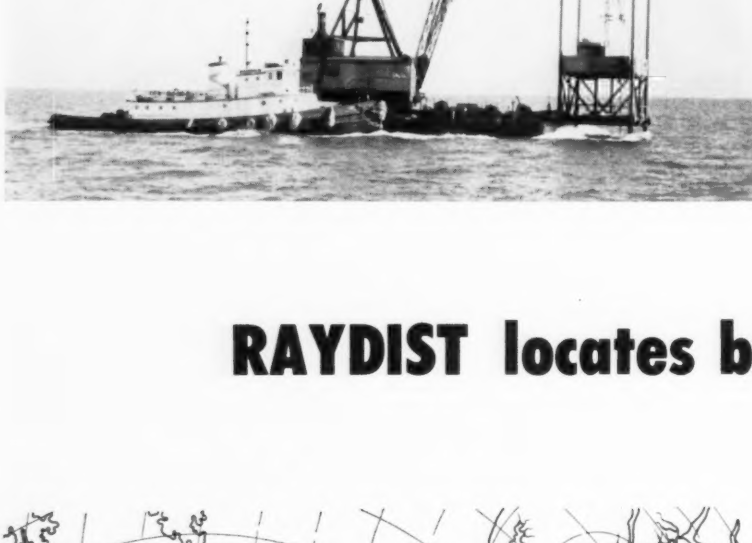
More and more standardized buildings are being selected by the larger engineering firms in metropolitan areas, by government agencies, and by younger firms. It is not any lack of professional skill that influences firms to select standardized buildings. They accept the vast amount of data available for use as intended—as good tools for obtaining quick and accurate answers. They find it wasteful of their time to use their talents in areas where good standardized products are available.



Towers for drilling were moved to Raydist-located position on a barge. Pipe supports were dropped through sleeves at each corner of frame and driven to hold tower firmly.

FIG. 1. (Below, left) Boring locations for a planned bridge and tunnel crossing of the mouth of Chesapeake Bay were established by Raydist, using observations on stations at Grandview, Va., and Oyster, Md.

RAYDIST locates boring sites for

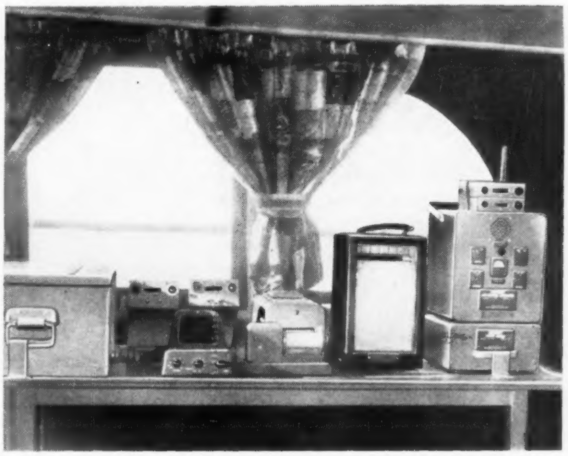


Raydist, a very accurate electronic navigation and positioning system, recently was used to quickly establish boring locations in open water across the mouth of Chesapeake Bay for a proposed bridge-tunnel project. The new facility will follow the route of the ferry from Little Creek, Va., to Kiptopeke Beach, Md.

For the first time Raydist equipment also was used in conjunction with subsurface sonar reflection equipment. The location work was done by Hastings-Raydist, Inc. of Hampton, Va. The sonar reflection survey work was done by Alpine Geophysical Associates, Inc., of Teaneck, N. J. All work was performed under the general supervision of Sverdrup and Parcel of St. Louis, the consulting engineers for the Chesapeake Bay Ferry Commission.

The proposed bridge-tunnel crossing is over 20 miles long and combines a tunnel under the main channel, a high-level suspension span, several smaller spans, and 12 miles of low-level trestle. Most of the roadway is 30 ft above the water.

To determine the depths of the various layers of sand, silt, mud, and rock, the thickness of these layers, and their physical characteristics, test borings



Raydist position-indicating equipment was installed on the Motorship "Robin" (above) in duplicate. In photo above right, two units on far right comprise one complete set of the newest transistorized Raydist equipment, a portable strip-chart recorder and a Raydist position indicator unit, complete with battery power supply and detachable position indicators (on top at far right). In center are the two larger position-indicating units and the strip-chart recorder, which were operated from the vacuum-tube Raydist equipment (under table). In front is an intercom set connected to the pilot on the bridge. At far left is automatic plotting board, which continuously made a direct map-type representation of ship's position.

Chesapeake crossing

ALLEN L. COMSTOCK
Head, Test and Evaluation Section, Hastings-Raydist Inc., Hampton, Va.

P. Z. MICHENER, M. ASCE
Principal Engineer, Sverdrup & Parcel, St. Louis, Mo.

were taken to depths of several hundred feet below the ocean floor. The sonar reflection survey along the proposed route permitted translating data from 24 borings to indicate subsurface conditions for the entire crossing. Use of Raydist speeded the location of towers for drilling and accurately located the subsurface soundings.

The name "Raydist" has been given to a whole family of continuous-wave, heterodyne, phase-comparison radio-location systems. All Raydist systems are based on the fundamental principle of determining distances or differences in distance in terms of the relative phase of an audio heterodyne. Basically, continuous-wave transmitters emit continuous radio signals, which differ from one another by audio frequencies. These heterodyne audio frequencies are received at two or more points. By comparing the phase of the signal as received at the various points and then relayed to a common location, accurate distance determinations can be made. Measurement of the precise distances to several points makes it possible to determine either two-dimensionally in a plane or three-dimensionally in space.

Many electronic devices for navigation and surveying have been developed in recent years but very few have been capable of determining position with the high degree of accuracy necessary for locating positions in such precise work as test borings. Pulse-type systems simply do not have the inherent accuracy which phase-comparison systems have. Early phase-comparison systems, while offering greatly improved accuracy over pulse-type units, were hyperbolic systems and were complex and difficult to use.

The DM Raydist System, a phase-comparison system of the latest type, offers exceedingly high accuracy and gives position data continuously and automatically in terms of direct range to two shore-based stations. The Raydist system used in the Chesapeake Bay operation consisted of two shore-based stations and duplicate Raydist position indicators mounted on the motorship *Robin*. One set was the newest transistorized Raydist equipment and the other was an older vacuum-tube system.

Each set of shipboard equipment included one unit incorporating all the electronic circuitry, two Raydist position indicators which were detachable and could be placed in any convenient location, a strip-chart recorder, and a battery power-supply. It was found that the most accurate control of the vessel was obtained when the captain was not required to observe the position indicators but was permitted to concentrate on maintaining a given heading. A small intercom set was used between the *Robin's* bridge and the Raydist equipment located in the vessel's main salon by which means heading changes and the like were given verbally to the captain.

The two shore stations were about 21 miles apart, spanning the mouth of Chesapeake Bay, one being located at Grand View, Va. (designated the Red Station) and the other at Oyster, Va., on the Cape Charles Peninsula (designated the Green Station). See Fig. 1. (With this same base line, the Raydist system has been used to accurately determine the speed of ships operated beyond the Atlantic Shelf more than 100 miles seaward.) The stations were of the 100-watt type, although the standard 10-watt equipment would have been entirely satisfactory for the purpose. The electronic components were enclosed in small, portable, weatherproof metal cases operated from conventional 110-volt power. The antennas were sectionalized aluminum guyed towers erected to a height of 100 ft. The

operation of each station was entirely automatic, requiring no manual adjustments.

On the vessel, Raydist dials and a recorder continuously indicated and recorded the distance from the *Robin* to the two shore-based Raydist stations. To plot the position of the *Robin* on a standard Coast and Geodetic Survey chart of the mouth of the bay at any given instant, the observer had only to draw two circles on the chart with a compass. One circle, using the Grand View Station as the center, would have a radius equal to the dial reading from the red indicator. The second circle, using Oyster, Va., as the center, would have a radius equal to the dial reading on the green indicator. The intersection of these circles provided an accurate fix of the position of the boat. See Fig. 1.

The fact that the Raydist Position Indicators operate automatically to give a direct reading of position is of special importance when operating on the water. Any unit or instrument that requires adjustment and manipulation or that requires aiming of a device toward some shore station in order to make a measurement would be totally worthless under the conditions of wind, tide and currents encountered along the North Atlantic coast in the wintertime. It would be impossible to hold a boat in a fixed position long enough to carry out such operations.

It was entirely practicable to calculate in advance the exact dial readings that the Raydist indicators would show when the ship reached the predetermined position—in this instance the spot at which one of the drilling towers was to be located. This permitted the *Robin* to go directly to the exact spot and to mark this spot with a buoy so that the drilling tower could be accurately positioned later.

The fact that the equipment also furnished a continuous strip-chart record of the position of the boat at all times throughout the operation was of particular value. This made it possible to return to any particular location at a later time if there was a need to check the data or to take additional samples.

The accuracy of Raydist is such that corrections were made for dropping the marker and buoy from the bow of the boat rather than from the point where the Raydist shipborne antennas were located. The accuracy of Raydist in this respect is much greater than that which it is practicable to incorporate in charts.

Each dial division of the Raydist position indicators represents a distance equal to a half wave-length of the frequency on which Raydist is operating. At the frequency used, the dials of the Raydist position indicators had a sensitivity of 18 in. per dial division. Repeatability was consistent to within a few feet, even under the widely changing atmospheric conditions that prevailed.

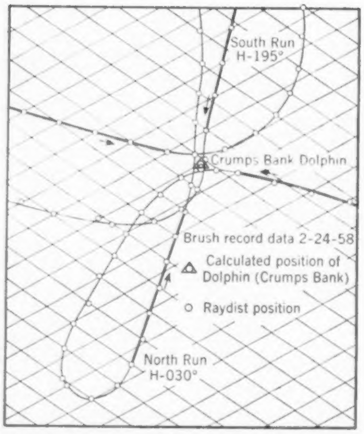


FIG. 2. Accuracy of Raydist was checked by observation on the Crumps Bank Dolphin. Raydist-equipped vessel approached on line from at least two directions in succession. Intersection of extended lines established position within 10 ft of that determined by best survey methods.

Raydist accuracies of 1 part in 5,000 or better can generally be expected under normal field conditions, and the accuracy can be considerably increased if special techniques are employed. While it was impossible under the circumstances to determine the absolute accuracy of the Raydist position data, it was possible, when weather permitted, to make optical checks of the boring-tower positions. These towers were generally found to be within 25 ft of the required locations.

It should be pointed out that effects of winds, tides and currents on the marker buoy at the time it is dropped overboard are the limiting factors in the accuracy obtainable, not the Raydist measurements. This was confirmed by the fact that when the positions of fixed objects such as lighthouses were determined optically and by Raydist, the measurements agreed to within 10 ft day in and day out.

Even in these checks some error was unquestionably introduced by the problem of piloting the boat with safety close enough to lighthouses, docks and pilings to check their position with accuracy. In some cases, the position of fixed objects was determined by having the vessel record its position continuously as it followed several different lines directly toward the pile or lighthouse being checked. The paths of the ship were then drawn statistically to a large scale, and their intersection gave an accurate fix of the location of the object. One such evaluation of the position of a lighthouse, made to compare Raydist and optical data, is shown in Fig. 2. The Raydist data checked with the optical within 10 ft.

Sverdrup and Parcel furnished Hastings-Raydist, Inc., with a detailed boring plan showing the exact spots, in terms of coordinates on the Virginia grid system, specified to the nearest foot, at which each boring should be made. The distance from each boring location to each of the two shore station antennas was then calculated to the closest foot and a table prepared showing the two Raydist readings for each boring position. An individual large-scale diagram, or "drop plan," of each position was then prepared showing the desired boring position and the Raydist range circles in the immediate vicinity.

The pilot of the ship was given a heading that would bring the vesel to the approximate location selected. When in the general area where the buoy was to be dropped, the ship was navigated along one range circle which corresponded with the desired position. The pilot was given a bearing on this line and was continuously given information concerning the accuracy of his position on the line so that he could correct for wind, tides, and currents.

The second dial continuously indicated how far away from the intended tower location the vessel was. As the vessel approached the location, a "count down" was used, indicating the number of feet from the desired tower location. The pilot was continually given corrections if the vessel veered from the line. If the vessel did not pass over the precise spot, the run was canceled and the vessel circled and came back on line for a second approach. When both dials indicated that the vessel was directly over the selected point, an anchor and marker buoy were dropped. The vessel then circled once more to check the position. The buoy's anchor was used as the drilling site; the buoy merely located the anchor.

A 20-ft square drilling tower, on a barge, was next moved into position directly over the buoy by small tugs. Anchors were set out from each of the four corners of the barge, and minor adjustments in position were made by the use of the barge's winches on the four anchor lines. The buoy anchor line was drawn up vertical so that the tower was placed directly over the anchor. After pipe piles were driven in sleeves in the corners of the tower, the tower was raised with a crane, pinned, and welded in position.

When the drilling tower was placed,

a check on its position was made by Raydist, and if weather permitted, additional checks were made by optical means. The exact position data provided by Raydist enabled a tower to be returned to any position at a later date if studies indicated that further data were desirable.

Sonar reflection equipment was installed on the *Robin* in addition to the Raydist equipment used for positioning the drilling towers. This equipment was capable of penetrating the subsurface materials several hundred feet to obtain "sonic reflections" indicating varying strata. As different types of subsurface materials were encountered, reflections were obtained and recorded, thus expanding and amplifying the data obtained in the borings.

Raydist guided the *Robin* along a precise, predetermined course and provided a continuous record of the vessel's location, correlated with the sonar reflection record. The sonar equipment used is somewhat similar to the seismographs employed in underwater oil exploration. Raydist has been used extensively in conjunction with seismograph equipment in the Gulf of Mexico since 1952.

Summary of statistics

The entire survey of the proposed crossing route was completed in less than 45 days. Actual Raydist operations in positioning for 24 open-water borings involved only 17 days. A buoy could be placed over a new boring site within two hours after its being requested. The over-all positional accuracy, including maneuvering of the *Robin*, dropping the buoy, moving the platform into position and making it secure, was about ±25 ft at sites up to eight miles from land.

The entire Raydist system was maintained and operated by two people. Both shore stations and the Navigator equipment aboard the *Robin* were completely automatic.

During the sonar towing operations, which required only 7 days including installation, calibration, operation, and removal of the equipment, a total distance of about 200 miles was covered.

Work of Hastings-Raydist Inc., was conducted by Allen Comstock, head of the firm's test and evaluation section, Floyd M. Gibbs, field engineer, and Jacob R. Worst, technician. The towers were set and drilling conducted by Raymond Concrete Pile Company's Gow Division, working as joint venturers with the Tidewater Construction Corp.

Sverdrup and Parcel, as engineers for the Chesapeake Bay Ferry Commission, are represented at the site by P. Z. Michener with Elmer Ott, Jr., as resident engineer.

Civil engineers and the law of supply and demand

ROBERT T. HOWE, A.M. ASCE

Assistant Professor of Civil Engineering, University of Cincinnati, Ohio

During the past year, while taking a course in economic theory, I became tremendously impressed with the power of the law of supply and demand. In my opinion civil engineers are in the grip of this law without being completely aware of it.

These and the following thoughts were brought into focus while I was studying "Engineering Education and the Civil Engineering Profession," the Opinion Research Corporation's report on which the Society's Task Committee on Professional Education based many of its recommendations. The report of this Task Committee, in the February 1958 issue of CIVIL ENGINEERING, p. 61, is "must" reading for everyone interested in the future of civil engineering as a profession.

Pricing theory states that, under pure competition, an equilibrium price will tend to be established where the supply curve intersects the demand curve, and that these two curves have opposite slopes, as shown in Fig. 1.

Product differentiation

One of the basic hypotheses of pure competition, however, is that the products offered and demanded are undifferentiated. Since every producer of goods and services strives to differentiate his product in some way, and different levels of purchasers desire different qualities in goods, something like the curves of Fig. 2 probably comes closer to representing the situation in most markets.

The basic desire to differentiate products is well illustrated by the old story of the four bakers all located on one street of a small town. One day the first baker posted a large sign outside his shop, "Best baked goods in town!" This prompted the second baker to put out a sign, "Best baked goods in the world!" to which the third baker responded with "Best baked goods in the universe!" Everyone wondered what the fourth and smallest shop would be able to claim. They soon found on it the sign, "Best baked goods on this street!"

The same drive for differentiation which motivated these bakers accounts for most of the progress in the automobile business, and for the wild advertising claims of the cigarette industry. "Snob appeal" is merely another form of differentiation, which may or may not include quality differentiation.

When deciding which supply curve to strive for, each producer must take into account his physical assets and the cost characteristics of his production facilities. In order to maximize his profits at any price level, he should produce the quantity of goods indicated by his marginal cost curves, as shown in Fig. 3. The most important consideration here is the fact that he can, in general, adjust his output to market prices.

One of the principal tasks of engineers employed by industry is to achieve product differentiation, and thereby to increase the demand for the company's product at a given price level. Because he contributes directly to the saleability of his employer's product, the mechanical, electrical, and chemical engineer is paid accordingly. In contrast, the civil engineer employed by industry seldom contributes directly to the income of the company, except perhaps in the case of railroads.

Doctors and lawyers are able to make the curves of Figs. 1 and 2 work to their advantage because they deal directly with the health and personal finances of individuals. Without the doctor's help, the patient might never earn another dollar. Without a lawyer, an injured person might never collect damages, or receive justice in a courtroom.

Effect on civil engineers

Instead of being able to take advantage of the supply and demand curves as discussed above, the civil engineer is hemmed in by circumstances which

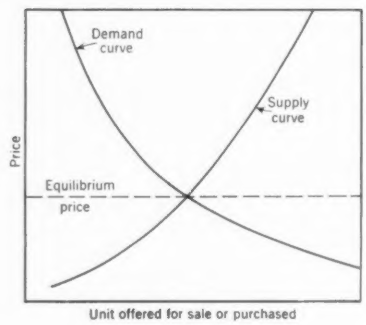


FIG. 1. Supply and demand curves for theoretical pure competition intersect at "equilibrium price."

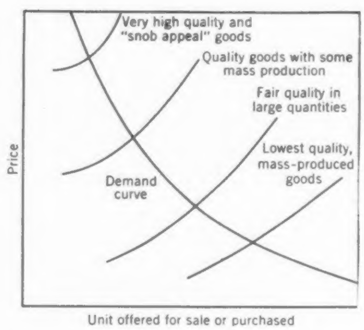


FIG. 2. Supply and demand curves are modified by product differentiation in four categories.

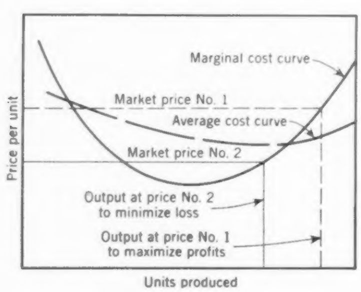


FIG. 3. To maximize profits at any price level, producer must regulate quantity of goods produced.

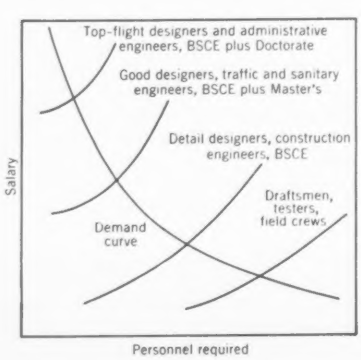


FIG. 4. Supply and demand curves for product differentiation (Fig. 2) are applied to civil engineers.

tend to keep his equilibrium price low, almost regardless of demand, a situation which the economist refers to as a highly elastic demand curve. The civil engineer is constantly working against the lowest bid with almost no hope of product differentiation or "snob appeal" to look to for added profits. Let us examine the roles of municipal, consulting, and construction engineers briefly from this angle.

Civil engineers employed by government must compete with tax collectors, firemen, policemen, and waste collectors for a position in the comprehensive salary scale. One needs only to imagine the contrast in public furor over a month-long strike by waste collectors and a similar one by the municipal engineers to realize the disadvantage under which the engineer labors.

Civil engineers in consulting practice very properly refuse to compete for work on the basis of prices, but what governmental agency will pay a higher fee than that which it has learned from experience is the lowest a reasonably competent firm will accept?

And how can consulting firms differentiate their work? No one can question the fact that there are potentially good designs and potentially bad designs for any structure or facility, but it is very difficult to say that one acceptable design is vastly superior to another acceptable design until both are built and compared. But is this possible? An automotive engineer can spend $10,000 and a year of time to reduce the cost of making a spark plug by one cent because a million of them will be sold. But what civil engineer can spend similar amounts of time and money to save even $10,000 on the cost of constructing one structure that will never be duplicated? And who will pay an extra ½ percent fee to get red-line prints on yellow paper?

Civil engineers employed by contractors are confronted with the phenomenon of the lowest bid. What contractor has ever been awarded a job at a premium price because he promised to use 4,000-psi concrete where 3,000-psi was specified? The jobs offered to contractors for bidding are so rigorously defined that only cost-cutting construction ideas will win awards. Since such ideas frequently become common knowledge after one job, the contractors' engineers tend to get bonuses for their ideas rather than sustained high salaries.

Role of ASCE

What does this inexorable law of supply and demand augur for civil engineers as individuals, and for civil engineering as a profession? It would seem to indicate (1) that the "equilibrium price" for civil engineers as a group is

not likely to rise much in relation to all other prices, (2) that each individual civil engineer will have to select the point of the total demand curve toward which he desires to strive, and then to prepare himself as completely as necessary to achieve that goal, and (3) that true professional stature will never be attained by more than the few who are especially endowed with luck, ability, and the "will to win." In Fig. 4 the supply curves of Fig. 2 are adapted to fit these special conditions of the civil engineer.

The Opinion Research Corporation's report, "Engineering Education and the Civil Engineering Profession," seems to point toward these same conclusions, for the interviewers found the two following outstanding characteristics among ASCE members of all grades: (1) more than 50 percent believe that the Society should be more concerned with improving their financial status; and (2) fewer than 50 percent take any active part in Society or community affairs. While similar results might well be found in other walks of life, such conflicting attitudes are certainly not the foundation stones on which to build a profession!

The American Society of Civil Engineers has worked hard during the past ten years to broaden its bases of usefulness to the membership, and to increase its attractiveness to new members, especially Juniors. The Report would seem to indicate that the members are taking less than full advantage of the changes they thought they wanted. Perhaps the Society should again go "highbrow" by adopting more stringent entrance requirements, and extending the "promotion up or rejection out" policy, which has long applied to Juniors, so that only really active members of the profession can attain full membership.

The American Medical Association, which is alluded to so frequently in conversations among engineers, has high membership requirements, including the demand that its members take at least one refresher course every two years. It would be interesting to know how many members of ASCE have never taken a refresher course, or have never attended a conference or a short course.

Civil engineering education

Thus far only the second half of the title of the Report has been considered —"The Civil Engineering Profession." We now come to the first half—"Engineering Education." On the basis of interviews with heads of civil engineering departments and deans of engineering in 28 leading colleges, the Report states in part, "The findings are part of the dilemma facing engineering educators. Many educators agree that some changes are called for in engineering curricula but there is not much agreement on what the changes should be." Perhaps Fig. 4 suggests a solution to this problem too.

In Fig. 4 the quality-differentiated supply curves of Fig. 2 are adapted to the various levels of civil engineering activity, the possessor of a BSCE being classified as a high-grade technician, as indeed he is immediately upon graduation. The curves indicate that only advanced study, which actually may be formal as shown, or informal self-improvement, will permit individuals to upgrade their equilibrium prices—regardless of acts of Congress which define engineering as a profession.

The demand curve of Fig. 4 indicates that many more technicians are needed than engineers of the highest professional grade. The ASCE booklet, "The Engineering Technician," suggests a ratio of five technicians to one engineer.

What must an engineering school do if it aspires to graduate the men who are likely to move upward to the comparatively few highest positions, rather than the many who will continue through life as technicians? First of all it must provide an inspiring faculty—only someone near the top can show the way to those below. Secondly, it must be much more selective in the students it accepts. It is well known that high standing in a high school class is little indication of real ability and, while entrance examinations are not foolproof, they should be more widely used. Third, and most important, the school should accept only mature students, without too much regard for age—students who know that they really want to become engineers.

No student enters a medical school who is not as certain as anyone can be that he wants to be a medical doctor. While not every student who enters a law school actually practices law, very, very few who set out to get an LLB do so without some plan for using this training. Meanwhile engineering schools are enrolling hundreds of 18-year-old boys whose parents or friends think that it would be "nice" if they studied engineering. The statement has often been made that it would be unwise to add an extra year to undergraduate preparation, or to require two or three years of work in arts and sciences before admission to engineering, because such procedures would discourage many students from entering engineering. If these statements are true, they may well be the most potent possible arguments for adopting just such procedures.

It is not unheard of for medical schools to require Masters' degrees of some applicants for admission. Might it not be wise for engineering schools to require some additional maturity, beyond the high school level, for applicants who give any indication of not being prepared for the rigors of an engineering education? It is estimated that, of all freshmen enrolled in college engineering courses, 60 percent drop out before graduation. Of this 60 percent, it seems evident that no more than 10 percent (or one-sixth) drop out because they cannot do the work required for graduation. The remaining 50 percent (or five-sixths) leave because of lack of interest or maturity or both. Why must this situation continue?

What can civil engineers do?

No doubt the above suggestions, if adopted, would greatly alter the pattern of civil engineering instruction in the United States. If a man has no desire to study, either formally or informally, beyond the Bachelor's level, there is no reason why he should be required to study any more mathematics, science, or humanities than are presently required, and perhaps considerable reason why he should have a "professional general" curriculum, as suggested in the interim report of the ASEE Grinter Committee Report, "An Evaluation of Engineering Education." On the other hand, students who really desire to move upward along the demand curve of Fig. 4 must have training beyond the Bachelor's level, and schools desiring to serve such students must adopt strong graduate programs, at least through the Master's level.

Yes, supply and demand is a powerful force, but not one that can be dealt with by collective bargaining, for this lowers the equilibrium price. However this force can be dealt with by individuals in any one of three ways: (1) they can choose to ignore it and become—or remain—frustrated; (2) they can recognize it and their present positions within its framework, and remain statically content; or (3) they can study it carefully and attempt to use it to their own advantage, just as every businessman attempts to do. Those who choose the third, and most difficult, path must prepare themselves to succeed eminently, or perhaps to fall somewhat short of their highest goals for some unforeseen reason. But even those who fall somewhat short will have some satisfactions, since "It is better to have tried and failed than never to have tried at all."

Where is your present position on the curves of Fig. 4? Where will your position be 5 or 10 years from now? How are you going to differentiate the product you have to offer in the market for civil engineers?

AMERICAN SOCIETY OF CIVIL ENGINEERS

Hydraulics Division Conference

Hosts: Georgia Section, ASCE, and the Georgia Institute of Technology

Architecture Auditorium, Georgia Institute of Technology, and the Atlanta Biltmore, Atlanta, Ga. **August 20-22, 1958**

REGISTRATION

Atlanta Biltmore, Crystal Lounge

Tuesday, Aug. 19, 4:00 p.m. to 9:00 p.m.
Wednesday, Aug. 20, 8:30 a.m. to 4:00 p.m.

Architecture Auditorium, Georgia Tech campus

Wednesday through Friday, 8:30 a.m. to 4:00 p.m.

Registration fee: $3.00 (Ladies and children, no charge). Please do not send payment in advance.

ADVANCE INFORMATION ON ATTENDANCE

Please let us know your plans. You will assist the Conference Committee in preparing for your visit by completing and mailing the coupon on page 122 at once.

MESSAGES

Messages for those attending the Conference should be addressed in care of the ASCE Hydraulics Conference Committee, Atlanta Biltmore, Atlanta, Ga. Messages will be held at the Ladies' Hospitality Desk in the Crystal Lounge, and notice of their arrival will be posted in the Architecture Auditorium.

AUTHOR'S BREAKFASTS

Atlanta Biltmore, Room 6, Mezzanine

7:30 a.m., Wednesday through Friday

The speakers and presiding officers for each day's technical sessions are asked to attend the Author's Breakfast on the morning of the same day. Program officials will explain the procedure for the conduct of the sessions and check arrangements for visual aids.

By invitation only. Cost: $1.00

LUNCHEONS

The Conference Banquet on Thursday night is the only scheduled meal function. A list of suggested eating places for midday lunches, including several on or near the Georgia Tech campus, will be available.

LADIES' HOSPITALITY ROOM

The main communications center for all ladies' activities will be the Crystal Lounge, just off the main lobby at the Biltmore, which will be maintained as a hospitality center throughout the Conference. Wives of guests arriving after Wednesday may register for ladies' and children's activities at the Hospitality Desk. Hostesses will be available to welcome you and help you make your visit in Atlanta an enjoyable and memorable one. Coffee will be served from 8:30 a.m. to 11:00 a.m., Wednesday through Friday.

WEDNESDAY MORNING

AUG. 20

Sponsored by Committee on Hydraulic Structures

Presiding: C. E. Kindsvater, President, Georgia Section, and Vice Chairman, Exec. Committee, Hydraulics Div.; Glenn Hands, Member, Hydraulic Structures Committee

9:30 **Greetings from the Georgia Institute of Technology**

DR. EDWIN HARRISON, President, Georgia Inst. of Tech., Atlanta, Ga.

9:40 **Flow Through Multi-Opening Constrictions in Open Channels**

PHILIP H. CARRIGAN, JR., and FREDERICK H. RUGGLES, Hydraulic Engrs., Research Sect., Surface Water Branch, U. S. Geological Survey, Atlanta, Ga.

10:10 **Discussion**

10:20 **A New Approach to the Hydraulic Design of Culverts**

HERBERT G. BOSSY, Highway Research Engr., Div. of Hydraulic

Architecture Building, Georgia Institute of Technology, where technical sessions of Hydraulics Division Conference will be held.

Research, Bur. of Public Roads, Washington, D. C.

10:50 Discussion

11:00 **The Highway Embankment as a Broad-Crested Weir**

C. E. KINDSVATER, Regents Prof., Georgia Inst. of Tech.; JACOB DAVIDIAN, Hydraulic Engr., U. S. Geological Survey, Washington, D. C.; and SHERWOOD P. PRAWEL, Graduate Student, Georgia Inst. of Tech., Atlanta, Ga.

11:30 Discussion

11:40 Adjourn

WEDNESDAY AFTERNOON

AUG. 20

Sponsored by the Committee on Sedimentation

Presiding: Harold M. Martin, Chairman, Exec. Committee, Hydraulics Div.; Alvin G. Anderson, Chairman, Sedimentation Committee

1:30 **Scour at Bridge Crossings**

EMMETT M. LAURSEN, Assoc. Prof., Michigan State Univ., East Lansing, Mich.

2:00 Discussion

2:10 **Design of Stable Channels in Alluvial Materials**

DARYL B. SIMONS, Project Leader, U. S. Geological Survey, Colorado State Univ., Fort Collins, Colo.

2:40 Discussion

2:50 Recess

3:00 **Analytical Study of the Mechanics of Scour for Three-Dimensional Jets**

YUICHI IWAGAKI, Assoc. Research Engr., Colorado State Univ., Fort Collins, Colo., and Asst. Prof., Kyoto Univ., Japan.

3:20 Discussion

3:30 **An Introduction to the Georgia Tech Hydraulics Laboratory**

DON B. JONES, Asst. Prof., Georgia Inst. of Tech., Atlanta, Ga.

3:45 **Conducted Tour of Georgia Tech Hydraulics Laboratory**

THURSDAY MORNING

AUG. 21

Sponsored by the Committee on Hydro Mechanics

Presiding: Joseph B. Tiffany, Secretary, Exec. Committee, Hydraulics Div.; Frank B. Campbell, Past Chairman, Hydromechanics Committee

9:00 **Hydraulic Studies of Concrete Pipe**

LORENZ G. STRAUB, Director, and CHARLES E. BOWERS, Research Assoc., St. Anthony Falls Hydraulic Lab., Univ. of Minnesota, Minneapolis, Minn.

9:30 Discussion

9:40 **Roll Waves and Slug Flow in Inclined Open Channels**

PAUL G. MAYER, Asst. Prof., Cornell Univ., Ithaca, N. Y.

10:10 Discussion

10:20 **Using the Colebrook-White Universal Resistance Relation for Open-Channel Flow**

ARTHUR T. IPPEN, Prof., Massachusetts Inst. of Tech., Cambridge, Mass. Sponsored by the Task Force on Friction Factors in Open Channels.

10:40 Recess

10:50 **Design Methods for Flow in Rough Conduits**

HENRY M. MORRIS, Prof. and Head, Dept. of Civil Eng., Virginia Polytechnic Inst., Blacksburg, Va.

11:20 Discussion

11:30 **Teaching Fluid Mechanics in the Laboratory**

M. R. CARSTENS, Prof., Georgia Inst. of Tech., Atlanta, Ga.

12:00 Discussion

12:10 Adjourn

THURSDAY AFTERNOON

AUG. 21

Sponsored by Committee on Tidal Hydraulics

Presiding: Wallace M. Lansford, Past Chairman, Exec. Committee, Hydraulics Div.; Eugene P. Fortson, Chairman, Tidal Hydraulics Committee

2:00 **A Model Study Approach to Salinity Problems in Vermillion Bay, La.**

HU B. MYERS, Chief Engr., Louisiana Dept. of Public Works, Baton Rouge, La.

2:30 Discussion

2:40 **Basic Studies on Salinity Intrusions in Tidal Channels**

ARTHUR T. IPPEN, Prof., and DONALD R. F. HARLEMAN, Assoc. Prof., Mass. Inst. of Tech., Cambridge.

3:10 Discussion

3:20 Recess

3:30 **Hydraulic Cycles at Southwest Pass, Mississippi River**

CHESTER A. PEYRONNIN, JR., Assoc. Prof., Tulane Univ., New Orleans.

4:00 Discussion

Garden and main entrance of Atlanta Biltmore, hotel headquarters of Hydraulics Division Conference.

CONFERENCE BANQUET

Thursday Evening, Aug. 21

Atlanta Biltmore

Presiding: Harold M. Martin, Chairman, Exec. Committee, Hydraulics Div.

Informal Dress

6:00 Social Hour, Crystal Lounge, Courtesy of Friends of the Georgia Section

7:00 Dinner, Georgian Ballroom

Greetings from the President

LOUIS R. HOWSON, President, ASCE

A Program of Negro Spirituals

Big Bethel Choir

FRIDAY MORNING

AUG. 22

Sponsored by the Committee on Flood Control

Presiding: Arthur T. Ippen, Member, Exec. Committee, Hydraulics Div.; J. F. Friedkin, Member, Flood-Control Committee

9:00 The Lower Mississippi River Project Flood Study

E. J. WILLIAMS, JR., Chief, Hydraulics Branch, and J. E. SANDERS, Chief, Hydrology Sect., Miss. River Commission, Vicksburg, Miss.

9:30 Discussion

9:40 Floods in the Florida Everglades Area

EDWIN W. EDEN, JR., Chief, Planning and Reports Branch, Eng. Div., Jacksonville Dist., Corps of Engineers, U. S. Army, Jacksonville, Fla.

10:10 Discussion

10:20 Recess

10:30 TVA Flood Control Experience—a 25-Year Backsight

REED E. ELLIOT, Chief Water Control Planning Engr., and LEROY ENGSTROM, Chief, River Control Branch, TVA, Knoxville, Tenn.

11:00 Discussion

11:10 The Hurricane Floods in the Carolinas

NELS C. MAGNUSON, Chief, Planning and Reports Branch, Wilmington Dist., Corps of Engineers, U. S. Engineers, U. S. Army, Wilmington, N. C.

11:40 Discussion

11:50 Adjourn

FRIDAY AFTERNOON

AUG. 22

Symposium on Water Use Problems and Water Rights Legislation in Southeastern States; Sponsored by Hydrology Committee

Presiding: Medford T. Thomson, Gen. Chairman, 1958 Hydraulics Conf.; C. C. McDonald, Member, Hydrol. Committee

1:30 Agricultural Water Problems

CECIL W. CHAPMAN, State Conservationist, U. S. Dept. of Agriculture, Soil Conservation Service, Athens, Ga.

2:00 Industrial Water Problems

T. M. FORBES, Exec. Vice President, Cotton Manufacturers' Assoc. of Georgia, Atlanta.

2:30 Municipal and Public Utility Water Problems

ROBERT E. STIEMKE, Director, School of Civil Eng., Georgia Inst. of Tech., Atlanta, Ga.

3:00 Recess

3:10 Trends in Water Rights Legislation

ROBERT H. MARQUIS, Solicitor, TVA, Knoxville, Tenn.

3:40 Forum Discussion

ROBERT E. STIEMKE, Moderator.

LADIES' PROGRAM

Wednesday, Aug. 20

A bus tour to Grant Park, where you will see the Cyclorama, world famous painting and diorama which depicts the Battle of Atlanta. Biggest painting of its kind in the world, it is 50 ft high and 400 ft in circumference.

Afterwards, a private style show and box lunch at Rich's, one of the nation's great department stores. What better excuse will you have to browse and shop before returning to your hotel?

Thursday, Aug. 21

Lunch at the Coach House, picturesque and different, and only a short stroll from the Atlanta Art Institute Galleries, through which you will take a leisurely tour after lunch.

In the evening, a cocktail hour, dinner, and entertainment at the Conference Banquet. Informal dress.

Friday, Aug. 22

A tour of some of Atlanta's beautiful residential streets, climaxed by lunch at the Argyle House, century-old plantation home famous for fine food served in a gracious atmosphere. Antiques, too.

CHILDREN'S PROGRAM

A program of entertainment and recreation, including a visit to the Wren's Nest (home of Joel Chandler Harris, author of the Uncle Remus stories), a trip to the Cyclorama and Grant Park Zoo, a barbecue picnic and a swimming party, will be designed to suit children of all ages. Baby sitters will be available for the very young while Mother is taking part in the ladies' activities.

POST-CONFERENCE FIELD TRIP

For those who are driving, the Coweeta Hydrologic Laboratory, near Dillard, Ga., extends a hearty welcome to tour the Laboratory on Saturday, August 23.

The Coweeta Hydrologic Laboratory, a division of the Forest Service, U. S. Dept. of Agriculture, was established in 1934 to develop basic principles for watershed management. It is located in the Nantahala Mountains, about 120 miles northeast of Atlanta and 80 miles southwest of Asheville, N. C. Using entire drainage areas as experimental models, foresters, agricultural scientists, and hydrologists have carried out land treatment and vegetational experiments on an unprecedented scale at this outdoor laboratory.

If you would like to receive more detailed information regarding the trip, please check the coupon on page 122, or write directly to Mr. Donald E. Whelan, Research Center Leader, Rural Delivery No. 1, Dillard, Ga.

COMMITTEES

General Chairman: Medford T. Thomson

Registration: Harry H. Barnes, *Chairman*, Irving W. Bearse, P. Hadley Carrigan.

Housing: Lewis A. Young, *Chairman*, Paul W. Richards, James V. Walters

Publicity: Leslie F. Johnson, *Chairman*, Benjamin L. Kittle, James W. Rabon

Program: Carl E. Kindsvater, *Chairman*, Trafton W. Fleetwood, Frederick A. Kilpatrick, Robert D. Wilroy

Exhibits and Tours: M. R. Carstens, *Chairman*, Don B. Jones, George M. Slaughter, Hubert J. Tracy

Finance: Benjamin M. Hall, *Chairman*, Arthur S. Booth

Entertainment: Richard King, *Chairman*, Edmond L. Belladonna, Charles L. Mills

Transportation: Paul M. Blair, *Chairman*, Laurence G. Leach, Kenith H. Miller, Douglas E. Schneible

Ladies' and Children's Program: Mrs. C. E. Kindsvater and Mrs. M. T. Thomson, *Co-Chairmen*, Mrs. H. H. Barnes, Mrs. M. R. Carstens, Mrs. L. F. Johnson, Mrs. D. B. Jones.

Watch your bolts

M. ZAR, M. ASCE, Associate, Sargent & Lundy, Engineers, Chicago, Ill.

Rapid acceptance, within a relatively few years, of high-strength bolts for field erection of structural steel has been remarkable. The first large-scale installations by this method were in 1953 and 1954. As soon as the initial inertia usually associated with a new concept was overcome, engineers and erectors became enthusiastic advocates of the bolting technique. It is evident that the A-325 bolt fulfills a need for a dependable fastener that can be installed rapidly with fewer men than are required for riveting. Economy is indicated by the fact that today almost all major structures are field bolted.

It may therefore be a rude awakening to some engineers to discover that the new fastener, if not properly installed under adequate inspection, may not be torqued sufficiently to develop the minimum specified tension.

Briefly, the fundamental function of the high-strength bolt is to place the field connection in friction by tensioning the bolt to at least 70,000 psi. This puts pressure on the hard washer placed under the head and under the nut, which creates the necessary friction.

A recent inspection of five power-plant structures erected by accepted methods with high-strength bolts in the past three years, revealed that on four of the jobs at least 20 percent of the bolts were under-torqued. On the fifth, almost all the bolts read low, and the steel erector returned to the job to retorque over 13,000 bolts in the more important shear connections.

The first four of these buildings were erected by the turn-of-nut method or a variation of it. [See M. H. Frincke's article, "Turn-of-Nut Method for Tensioning Bolts," Civil Engineering for January 1958, p. 63.] The fasteners on the last mentioned structure were installed with calibrated impact wrenches in the following manner (see "High-Strength Steel Bolts in Structural Practice," by Mace H. Bell, A.M.ASCE, ASCE *Transactions*, 1957):

Each impact wrench was calibrated once a day by a device fastened to a gage which was adjusted to read accurate tension in the bolt. The air pressure required for each wrench to properly tighten a bolt of a given diameter was recorded and as long as this air pressure was maintained, by means of valves and gages in the air line, the wrench should have provided the proper tension for each bolt, unless the operator did not run the wrench till it stalled. The owner's engineers, as well as an independent testing laboratory, kept written records of the minimum air pressure required for each wrench on each size of bolt used each day.

The above experience makes it imperative that all steel erection specifications include rigid procedures for installation and inspection of bolts. Many readers may question the necessity for requiring that all bolts in a given connection be properly torqued. Since research and tests reveal that each A-325 bolt at specified tension is more than the equivalent of a rivet of equal diameter, and since we replace all field rivets in our design of connections with an equal number of bolts, it may be asked, "What harm will result if the connection is only 80 percent effective?"

The answers to that question become evident on reflection:

1. There may be too many under-torqued bolts in any one connection to develop the required strength in the joint.
2. We do have an accepted specification approved by the Research Council on Riveted and Bolted Joints of the Engineering Foundation which requires minimum tension in each bolt, and specifications should be adhered to, especially since we are working with a relatively new method.
3. The Research Council is preparing a new specification which will attempt to reduce the number of bolts in a connection by recognizing that the A-325 bolts are superior to rivets. It behooves us, therefore, to utilize the interim period to improve our procedures for installation, and especially for inspection, to insure that each and every bolt can be relied upon to perform its job.

The impact wrench with calibrated air control presents a number of difficulties such as:

1. There may be two or more bolt sizes in one joint requiring different air pressures for different wrenches.
2. Lengths of hoses must be restricted to avoid drops in pressure.
3. Restricted air pressure may cause further complications if air is required for other purposes, such as for chipping.
4. If the nut is inaccessible, the wrench socket may have to be placed on the bolt head, and more air pressure is required to tighten the fastener from the bolt end.

In view of the fallibility of calibrated impact wrenches, the following specification for the installation of high-strength bolts is recommended:

"1. Fair-up holes in each connection with enough pins to maintain the dimensions and plumbness of the structure. These pins shall remain in place until all the bolts in the remainder of the holes have been tightened.

"2. Install and tighten enough fit-up bolts to insure that the connected parts are properly fitted.

"3. Install bolts in the remaining holes and spin the nut of each of these bolts to a snug condition with the impact wrench, then continue to tighten it *at least* one-half turn. The chuck of the wrench must be marked to permit visual observation of its rotation.

"4. Replace pins with bolts and tighten as in Step 3.

"5. Check the torque of each fit-up bolt with the impact wrench by tightening one-quarter turn. If these bolts do not appear to be tight, they shall be made snug and impacted one-half turn as in Step 3."

To maintain adequate checks and a high standard of performance, an independent inspection service should be engaged by the owner to perform under the following specifications:

"Each day three bolts of each required size shall be tested in a tension device, such as the Skidmore-Wilhelm

calibrator. Bolts shall be tightened to the following tension:

Bolt Size Inches	Required Minimum Bolt Tension, lb
5/8	17,250
3/4	25,600
7/8	32,400
1	42,500
1 1/8	50,800
1 1/4	64,500

"The inspector, by means of a laboratory-calibrated torque wrench, shall test the torque on each tightened bolt and average three readings to establish a torque-tension relationship for each bolt size, and this ratio is the norm by which he shall check bolts for that day. Because of differences in thread cutting and anti-rust liquids, bolts vary, and it is important to set standards for each day.

"In each connection on the structure, approximately 10 percent of the bolts shall be tested, but never less than two. The inspector shall place his wrench on the nut, make a mark across the building steel and the chuck, back off the nut, return it to its previously marked position, and read the dial on his wrench, comparing this reading with the required torque. If the inspector discovers one or more bolts which are under-torqued, all the bolts in the connection shall be tightened with the impact wrench by the erector and shall be checked again by the inspector."

There is an impact wrench on the market that can be set by means of a torsion bar to discontinue impacting at a preset torque. There have been two objections to its use. First, it is heavier than other wrenches. Second, it cannot be used for torques greater than that required for 7/8-in.-diameter bolts.

These objections may be overcome in a newer wrench recently developed but not yet proven in the field. Some who have tried it state that its results are inconsistent.

It may be that a good, controlled-torque impact wrench will be the answer to the problem encountered with the installation methods used to date.

There is no doubt that, even with the less-than-perfect jobs that have been mentioned, field bolting still outweighs riveting in its advantages. But to get the greatest benefit from the bolting procedure, a visible turn-of-nut method is needed, together with tight fit-up of steel.

Spacing of vertical U-shaped stirrups in concrete beams

W. I. BARROWS, M.ASCE, W. I. Barrows & Associates, Dayton, Ohio

Shortly after the turn of the century, the late Prof. Arthur W. French, M.ASCE, then Head of the Civil Engineering Department of the Worcester Polytechnic Institute, was teaching the principles of reinforced concrete design from a sheaf of longhand notes, primarily because he felt that a suitable textbook on the subject had not been published. His method of spacing stirrups was as follows:

Nomenclature:

V_s = total shear carried by stirrups, lb
$d - z$ = effective depth of the beam, inches
a_s = area of stirrup bar, inches
f_s = stress in steel, psi
S = spacing of stirrups, inches

Assumptions:

Two assumptions only, were made:

1. That the beam would tend to fail in shear on an arc, the chord of which would be inclined upward at about 45 deg and therefore

2. A sufficient number of stirrups must be spaced horizontally, in a distance equal to $d - z$ to resist the shear, V_s. See Fig. 1.

The formula then becomes:

$$\text{Number of stirrups} = \frac{V_s}{2a_s f_s} \quad . . . (1)$$

$$\text{Their spacing, } S = \frac{d - z}{\dfrac{V_s}{2\,a_s\,f_s}} \quad . . . (2)$$

$$S = 2\,a_s f_s\left(\frac{d - z}{V_s}\right) \quad (3)$$

At present the formula used for the spacing of vertical stirrups in concrete beams is:

$$P = v'bS \quad . . . . (4)$$

where P = load carried by one stirrup, lb
v' = unit stress to be carried by stirrups
b = width of beam, inches
S = spacing of stirrups, inches

but $P = 2\,a_s f_s$, and $v' = \dfrac{V_s}{b\,(d - z)}$

$$\text{Therefore } 2\,a_s f_s = \left(\frac{V_s}{(d - z)}\right) S$$

$$\text{and} \quad S = 2\,a_s f_s\left(\frac{d - z}{V_s}\right) \quad (5)$$

From Eqs. 3 and 5, it is obvious that the formula for the spacing of vertical stirrups in use today is the same as that devised by Professor French some five decades ago.

The next question is to determine how this formula is to be applied. The beam in question has already been designed and the spacing of the stirrups is about the last determination required of the designer. One setting of the slide rule will determine the value of $(d - z)/V_s$, and a table of values of $2\,a_s\,f_s$ can be prepared, as shown in Table I. The product of these two values is the stirrup spacing, in inches.

Equation 5, and its solution, covers only the stirrup spacing for any specific value of V_s and in general is applicable to beams having horizontal shear diagrams, as shown in Fig. 2.

As Eq. 3 involves only three variables,

Fig. 1. Stirrups must be spaced horizontally, in distance $d - z$, to resist shear V_s.

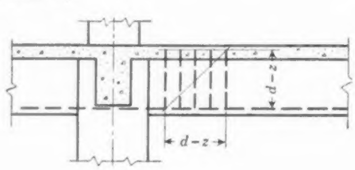


Fig. 2. For beams with horizontal shear diagrams, Eq. 5 is applicable, using specific value of V_s.

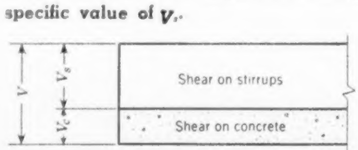


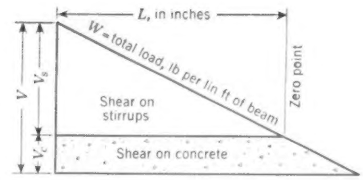
TABLE I. Values of $2\,a_s f_s$

Stirrup		Values of f_s, psi				
Bar No.	Approx. Dia., in.	16,000	18,000	20,000	22,000	24,000
2	1/4	1,600	1,800	2,000	2,200	2,400
3	3/8	3,520	3,960	4,400	4,840	5,280
4	1/2	6,400	7,200	8,000	8,800	9,600
5	5/8	9,920	11,160	12,400	13,640	14,880
6	3/4	14,080	15,840	17,600	19,360	21,120

TABLE II. Values of $24\,a_s f_s$

Stirrup		Values of f_s, psi				
Bar No.	Approx. Dia., in.	16,000	18,000	20,000	22,000	24,000
2	1/4	19,200	21,600	24,000	26,400	28,800
3	3/8	42,240	47,520	52,800	58,080	63,360
4	1/2	76,800	86,400	96,000	105,600	115,200
5	5/8	119,040	133,920	148,800	163,680	178,560
6	3/4	168,960	190,080	211,200	232,320	253,440

Fig. 4. For beams with sloping shear diagrams, Eq. 6 is applicable.



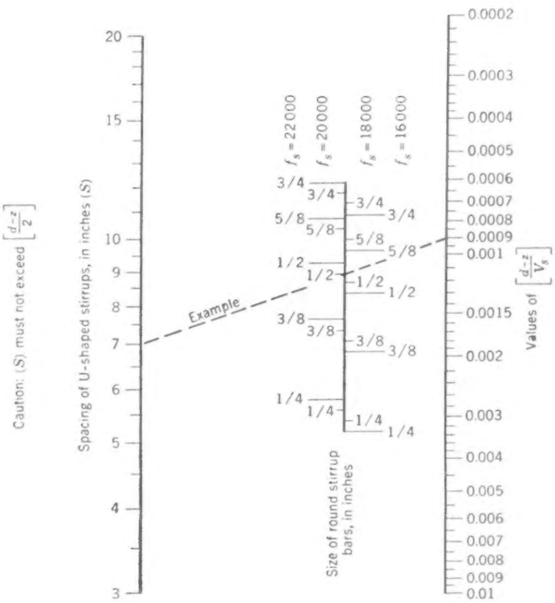
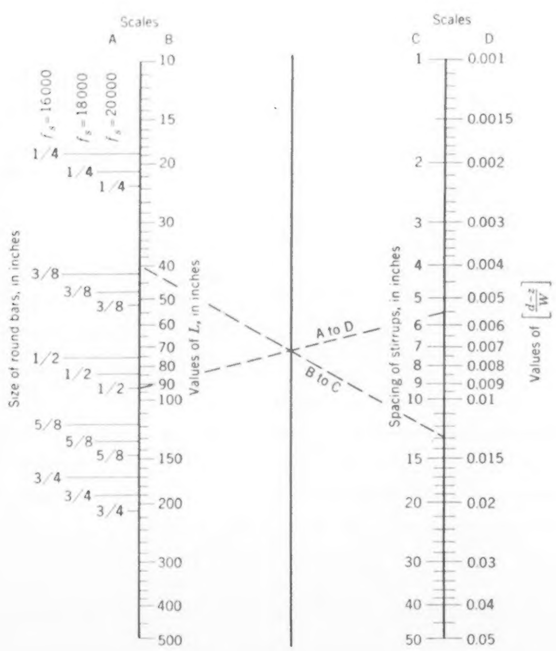


Fig. 3. Stirrup spacing, for beams with horizontal shear diagrams, is read from left-hand scale.

Fig. 5. Stirrup spacing, for beams with sloping shear diagrams, is read from Scale C.



it is a simple matter to prepare a nomographic chart that is applicable to practically all conditions. Such a chart is shown in Fig. 3.

For beams having sloping shear diagrams (Fig. 4), it is necessary to further modify Eq. 3.

Now $V_s = W(L/12)$, and Eq. 3 becomes:

$$S = 2\,a_s f_s\,(d - z)\,\frac{1}{WL/12}$$

$$\text{Or}\quad SL = 24\,a_s f_s\,\frac{d - z}{W} \quad . \; . \; . \; . \quad (6)$$

Again, the value of $(d - z)/W$ is a simple slide-rule calculation and a table of values can readily be prepared for $24\,a_s f_s$, as is shown in Table II.

Inasmuch as $(d - z)/W$ is a constant for any particular beam and $24\,a_s f_s$ is a constant for any particular stirrup, Eq. 6 becomes

$$SL = \text{a constant} \quad . \; . \; . \quad (7)$$

from which it is apparent that the stir-

rup spacing, in inches, is a function of the reciprocal of the distance from the "zero point" to the particular stirrup in question, also in inches.

Example solved

To illustrate the spacing of stirrups by the slide-rule method, let the following set of conditions be assumed: $d - z = 28$ in.; $L = 80$ in.; $W = 6{,}000$ lb; and $f_s = 16{,}000$ psi.

Then $24\ a_s f_s = 76{,}800$ (for ½-in. stirrup, Table II)

$$(d - z)/W = 28/6000 = 0.00467$$
$$SL = 0.00467 \times 76{,}800 = 359$$

Then the spacing of ½-in. round stirrups will be:

L	S	Collecting
80″	1 @ 2″ (arbitrary)	1 @ 2″
78″	1 @ 4″	2 @ 4″
74″	1 @ 4″	3 @ 5″
70″	1 @ 5″	1 @ 6″
65″	1 @ 5″	1 @ 7″
60″	1 @ 5″	1 @ 8″
55″	1 @ 6″	1 @ 10″
49″	1 @ 7″	2 @ 12″
42″	1 @ 8″	....
34″	1 @ 10″	....
24″	2 @ 12″	....
0″	None	....

In arriving at the above, the following conditions have been assumed:

1. The first stirrup will be arbitrarily spaced 2 in. off the support.
2. No fractional spacings will be used.
3. The maximum spacing shall not exceed $(d - z)/2$

Referring to Eq. 6, it will be noted that, for beams having sloping shear diagrams, the stirrup spacing involves four variables and consequently the solution can again be found by means of nomographic charts. For the benefit of those designers who prefer to use charts, such a chart has been prepared and is shown in Fig. 5.

Computation of sequent depth in hydraulic jump simplified

TURGUT SARPKAYA, A.M. ASCE, Assistant Professor of Engineering Mechanics, University of Nebraska, Lincoln

A commonly used equation for the stationary jump in a rectangular channel is

$$d_2 = -\frac{d_1}{2} \mp \sqrt{\frac{2\,q^2}{g\,d_1} + \frac{d^2{}_1}{4}} \quad . \quad . \quad . \quad (1)$$

in which d_1 and d_2 represent the depths before and after the jump respectively. And q is the discharge per unit width of the channel. Equation 1 may be written as follows:

$$\frac{d_1}{d_c}\frac{d_2}{d_c}\left(\frac{d_1}{d_c} + \frac{d_2}{d_c}\right) = 2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

in which d_c represents the critical depth. If the following substitutions are made,

$$\sqrt[3]{2}\, d_c = s = \sqrt[3]{\frac{2\,q^2}{g}};\ \frac{d_1}{s} = X;\ \frac{d_2}{s} = Y.$$

Eq. 2 is reduced to

$$X \,.\, Y\,(X + Y) = 1 \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Taking the logarithms of both sides,

$$Ln\, X + Ln\, Y = Ln\,\frac{1}{X + Y} \quad . \quad . \quad (4)$$

If either X or Y is known, the other variable could easily be obtained with the help of an ordinary slide rule. Take any slide rule which has the reciprocals of numbers on the stator directly under the normal graduation (for instance, a Pickett dual-base log-log slide rule). Then the computation proceeds as follows. See Fig. 1.

Place the left index of the slide at X on the stator, if the hair pin is on the correct value of Y, it is also on the $(X + Y)$ value of the reciprocals graduation on the stator, as shown on the accompanying Fig. 1. This is an obvious feature of a slide rule. Since Y is not known originally, assume any value and compute $X + Y$. Move the hair pin onto $X + Y$ on the reciprocals, read Y on the slide, compute $X + Y$ and repeat the procedure. No matter how rough the first trial may be, the exact value of Y will be obtained in three or four trials and in a less than two minutes of time by this method.

The following example will illustrate the use of this procedure. Given a unit discharge $q = 32.1$ sq ft per sec, and $d_2 = 4.8$ ft. Therefore $s = 4$ and $Y = 1.2$. Place the left index of the slide on 1.2, and assume $X = 0.40$.

The following readings must then be made successively:

Compute $1.2 + 0.40 = 1.60$; put the hair pin on 1.60 on reciprocals; read 0.52 on the slide.

Compute $1.2 + 0.52 = 1.72$; put the hair pin on 1.72 on reciprocals; read 0.49 on the slide.

Compute $1.2 + 0.49 = 1.69$; put the hair pin on 1.69 on reciprocals; read 0.494 on the slide.

With little effort the final value of $X = 0.492$ can be obtained. Hence

$4 \times 0.492 = 1.968$ ft, which is the depth before the hydraulic jump.

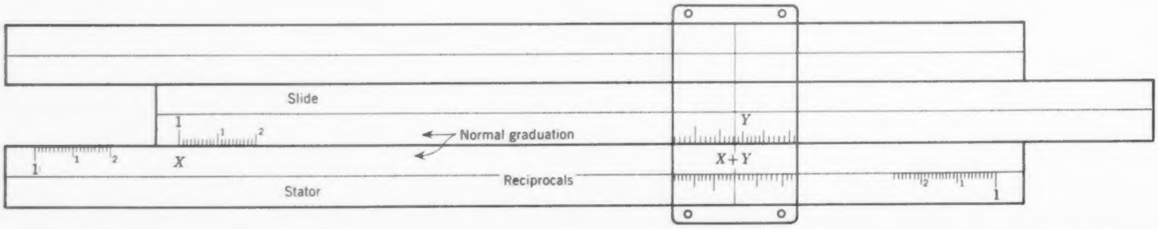


FIG. 1. Any slide rule which has the reciprocals of numbers on the stator directly under the normal graduation can be used to compute sequent depth in hydraulic jump.

Limited deflection of beam by chart

THOMAS D. Y. FOK, A.M. ASCE

Design Engineer, Richardson, Gordon & Associates, Pittsburgh, Pa.

In building design the total deflection of a beam is usually restricted by a limiting value. Where a plastered ceiling is placed under the beam, the limit is set to prevent cracking of the plaster. Common limits are in ratios of the span, such as 1/360 for the above case. For a given permissible fiber stress there is a definite relationship between this ratio and the ratio of depth of member to span length.

Deflection of the beam can be expressed as follows (see Thomas Clark Shedd, *Structural Design in Steel*, John Wiley & Sons, Inc., New York, 1934, p. 112):

$$\Delta = C_1 \frac{S\,L^2}{E\,d} \quad \ldots\ldots \quad (1)$$

where Δ = deflection in inches
L = span in inches
E = modulus of elasticity of beam in lb per sq in.
S = extreme fiber stress in lb per sq in.
d = depth of beam in inches
C_1 = a coefficient depending on the loading condition

The values of C_1, the deflection coefficient, are as follows for different loading conditions:

Loading	Coefficient C_1
Uniformly distributed load	0.209
One concentrated load at center of beam	0.167
Equal concentrated loads at third points	0.213
Equal concentrated loads at quarter points	0.198
Equal concentrated loads at fifth points	0.210

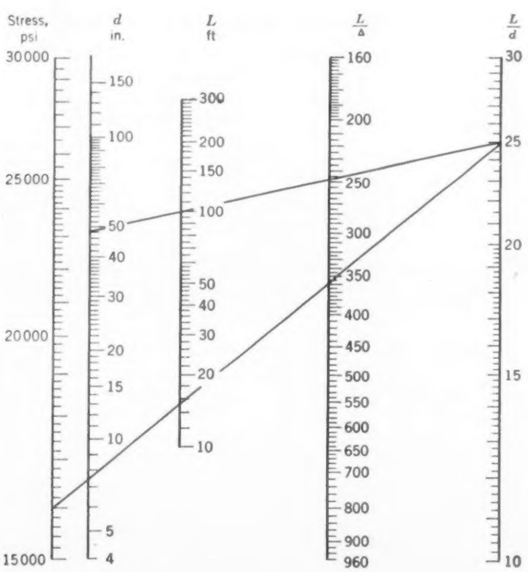
The chart, Fig. 1, shows the relation of L/Δ to L/d for a uniformly distributed load with a modulus of elasticity of E = 30,000,000 psi and a given design stress, S.

For example, if S = 16,000 psi, and d/L is limited to 1/360, Δ/L is equal to 1/25 by substituting the given values in Eq. 1. In Fig. 1, if a straight line is drawn through points L/Δ = 360 and S = 16,000, it will cut the L/d scale at 25. Since L/d is determined, the depth of a beam for a given span L, in ft, can be obtained by reading the value from the d scale at the point where a line passing through L/d and L intersects it. For example, where L/d = 25 and L = 100 ft, the depth d = 48 in.

For other loading conditions, L/Δ and L/d values are obtained by multiplying the chart values by the ratio of C_1 for a uniformly distributed load to the C_1 of the given loading condition. For example, if the design load is a concentrated load at the center of the span, the correct L/Δ or L/d values are equal to the values for L/Δ and L/d obtained from Fig. 1, multiplied by 0.209/0.167.

If a modulus of elasticity other than 30,000,000 psi is used, the values obtained from the chart should be multiplied by the ratio of the given modulus of elasticity E to the 30,000,000 psi used in the chart. The values on the L and d scales are not affected by a different loading condition or a different modulus of elasticity.

FIG. 1. Chart gives relation of L/Δ to L/d for a uniformly distributed load where modulus of elasticity E = 30,000,000 psi and design stress is given.



THE READERS WRITE

Revision in "turn-of-nut" method suggested

To THE EDITOR: In the January 1958 issue, M. H. Frincke presented an interesting and timely article entitled "Turn-of-Nut Method for Tensioning Bolts." The "turn-of-nut" method has decided advantages in field application. However, in the seven steps he outlines there is one questionable point.

In Step 6 he states: "Check the torque of each fit-up bolt with the impact wrench. Usually no further torquing is required. Some may require one-quarter turn."

To check the torque with a regular impact wrench (not a calibrated impact wrench), the operator must rely on the "feel" of the wrench, which is one of the things that the "turn-of-nut" method is attempting to do away with. I feel that the following procedure for Step 6 would be more correct.

"Back off the nut on each fit-up bolt (these bolts previously having been marked), spin the nut to a 'snug' condition, then continue to tighten at least one half to one turn depending on the grip length."

This would result in more uniformity of tension in the bolts of the connection.

C. S. MORGENTHALER, J.M.ASCE
Bridge Designer, Joseph K. Knoerle & Associates, Inc.

Baltimore, Md.

Author replies

To THE EDITOR: Mr. Morgenthaler's suggestion is good and will insure at least one-half turn of the nut after it has been brought to the snug position. It does, however, involve extra labor cost which will eventually add cost to the structure.

Experience on the job has shown that bolts used in fitting a joint have usually been tightened to a tension well beyond that given by the half turn of the nut and to a tension beyond that required.

As any tension over 90 percent of proof load, and still short of bolt failure, should result in a better fastener, we are not concerned about putting a higher tension in these bolts used for fitting-up. However, there is no need to tighten all bolts to the extent that fitting-up bolts are usually tightened in the fitting-up process. The half turn from snug for all bolts, other than those used for fitting-up, gives a tension in excess of requirements and is economically obtained as it is easy to observe by watching the 180-deg markings on the sockets.

Any bolt used in fitting-up that fails in tension or by stripping of the thread of the nut or bolt is of course replaced.

Seldom if ever does a nut on a bolt used in fitting-up move at all upon reapplication of the impact wrench. If the nut does turn upon such reapplication, it is allowed to move until the wrench "stalls." A wrench capable of giving one-half turn of a nut from snug and still be turning is "calibrated" for tension in excess of minimum requirements; therefore, the fitting-up bolts may be considered tested by a "calibrated" impact wrench.

M. H. FRINCKE, A.M.ASCE
Manager of Erection, Bethlehem Pacific Coast Steel Corp.

Alameda, Calif.

Teach engineering in its human context

To THE EDITOR: Engineers continue to complain about their status.

We seem to believe that if we follow our professional ideal of "service to mankind" we are sure to be highly regarded. And when disappointed by the meager prestige we actually enjoy, we tend to blame each other for falling short of the ideal, and exhort our recruits to greater dedication.

Prestige is not won by a group as such, but by the individuals comprising it. A man is respected for his personal qualities and his profession through him, not vice versa. If we want self-respect and recognition, therefore, we must seek them as individuals.

But "service to mankind" is not an adequate ideal for the individual. Professionally the individual may be a servant of mankind, but as a man he *is* mankind, and the difficult technical servants are his to master.

In our society, where the majority of thinking men are concerned with technical means, the most truly valuable are the few concerned with human ends. Are engineers among that few, and if not, why not?

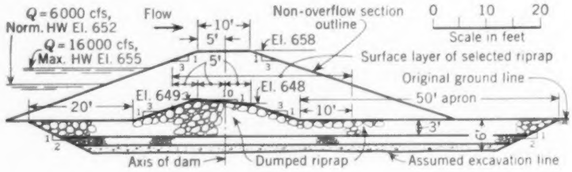
One answer must be that a technical training is no education. In current attempts to make it so, courses in the humanities are run parallel and subsidiary to the technical courses. Technical analysis appears all important. The study of its human source and purpose is hung on as a lightweight appendage.

Engineering has perhaps not been understood as a "subject" since its entry into the academic world. The medieval centers of learning had been concerned only with the ends of man, and engineering crept in disguised as pure science or math, ends in themselves as quests for truth.

The disguise should go. The techniques of engineering are not human ends themselves but means to ends. An engineering course should therefore concern itself with history as much as with science. Discussion of engineering problems should include not only the "how" of present solutions but also their "who" and "why" in history. Engineering can be an education in itself, needing no "liberalizing"

Loose-rock spillway safely passes 9,000 cfs

To THE EDITOR: I read with interest the article by Messers. Barr and Rosene, "Loose-rock Spillway for Low-head Dams," in the April issue, p. 50.



It may be of interest that a similar spillway was designed by the Harza Engineering Company in 1955 and built the same year by Lake Asbestos of Quebec, Ltd. for the Trout Lake Dam.

As the accompanying section shows, the Trout Lake spillway has a capacity of 16,000 cfs. Last year a flood of about 9,000 cfs was safely passed. Since the spillway length is 350 ft, 25 cfs per lin ft of spillway was discharged. At design flood, 45 cfs per lin ft of spillway would flow over the spillway.

In our constant search for more economical structures when conditions permit, such structures show promise in replacing more conventional and more expensive concrete spillways.

It is interesting to see that engineers working independently have arrived at such similar conclusions.

B. M. JOHNSON, M.ASCE
Harza Engineering Co.

Chicago, Ill.

courses on the side, if it is taught complete with its human context.

We should not dilute our science, but teach it more dramatically. Students will better understand technical principles by learning their evolution in history, and more quickly develop the creative approach by seeing the human needs behind their problems.

By stronger teaching we can make a truly strong profession.

JOHN BULMAN

445 East 68 St.
New York, N. Y.

IBM 650 translates decimal to bi-quinary system

TO THE EDITOR: I would like to call your attention to a statement made by Steven J. Fenves, J.M.ASCE, in his article in the May 1958 issue, "Computers Shown at ASCE Chicago Convention." In discussing the IBM 650 he states, "Computations in the 650 are performed in the decimal number system, and are carried to 10 significant digits."

May I quote from the IBM 650 Manual of Operation, "The type 650 translates the decimal digit representation of the input data into bi-quinary digit representation for internal transmission and use."

HAROLD OSLICK, J.M.ASCE
Graduate student,
Univ. of Pa.

Philadelphia, Pa.

Pole embedment to resist lateral load

TO THE EDITOR: Recent articles in the Engineers' Notebook section of CIVIL ENGINEERING ("Piers supported by passive earth pressure," by Noble G. Robbins, Structural Engineer, Pure Oil Company, Chicago, Ill., April 1957, and "Finding depth of footing for a pole subject to lateral loads," by Ivan M. Nelidov, M.ASCE, Civil and Structural Engineer, San Francisco, Calif., March 1958), appear to fall short of the purpose stated in their titles through attempting to oversimplify a complex problem. In both articles the basic assumption is made that the maximum value for passive earth pressure can be used, and the angle of internal friction is taken as 33°41′. This value implies a soil equivalent to a dry sand.

Actually the passive earth pressure varies widely for different soils, and with the moisture content for a specific soil. It is extremely important that some effort be made to determine a reasonable value for this factor to be used in the computation for the required depth of embedment.

A large amount of experimental work has been done on the problem of lateral forces applied to embedded poles and piles. From the resulting data various formulas have been derived, some involved, others simple. A serious objection to the more complicated formulas is that sufficient precise data on the characteristics of the soil are seldom available to justify the refinements.

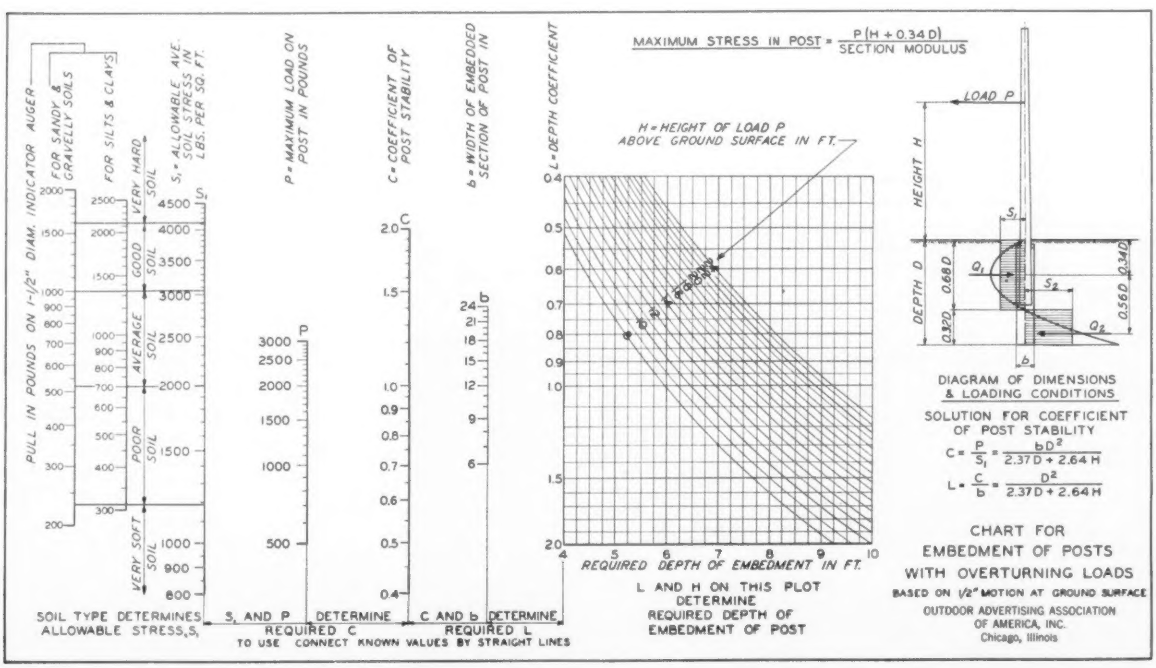
A comparatively simple method, which has been verified by a number of independent investigators in full-scale tests, was developed by P. C. Rutledge, Director ASCE, while a professor at Purdue and Northwestern Universities, for the Outdoor Advertising Association of America. It requires some preliminary investigation of the soil. This may be quite limited for a minor installation, or more comprehensive for a larger, more important project. In any case, some appraisal of the soil at the site is necessary.

The Rutledge "Chart for Embedment of Posts with Overturning Loads," here reproduced, is a nomograph based on four known factors, allowable average soil stress, maximum horizontal load on the pole, average width of the embedded section of the pole, and height of the horizontal load above the ground line. It gives the required depth of embedment. With any four of the five factors given, or assumed, the remaining one can be readily obtained from the nomograph below.

The Rutledge "chart" is reproduced here through the courtesy of the Outdoor Advertising Association of America. It is given in a number of publications, among them that of the American Wood Preservers Institute, 111 West Washington Street, Chicago 2, Ill., *How to Design Pole-Type Buildings.* This publication also gives the derivation of the equation for depth of embedment and of the two parameters used in the nomograph.

DONALD PATTERSON, M.ASCE
Structural Engineer

Ferndale, Mich.



SOCIETY NEWS

ASCE Annual Convention to Feature International Conference

A week-long conference, sponsored by the Structural Division and the International Association for Bridge and Structural Engineering, will highlight the Society's Annual Convention, scheduled for New York City in October. Speakers at the joint sessions will represent the professional interests of a dozen nations, and a large international attendance is anticipated. While the conference will give an international flavor to the entire Convention, a special day and special ceremonies will recognize the engineers attending from other nations. The set-up and work of the International Association for Bridge and Structural Engineering are described in another item in this department. The joint program is summarized in Division Doings.

In addition to the joint international program, nearly 200 engineers will present important new information during the 45 sessions the Technical Divisions are scheduling for the Annual Convention. Starting on Monday, October 13, these sessions will run for five complete days at the headquarters hotel, the Statler-Hilton.

In response to the demands of the membership for fewer conflicts in the technical sessions, this year's program will feature fewer sessions running simultaneously, and more of them as cooperative efforts of two or more Technical Divisions.

Annual Business Meeting

Another stellar feature of the Annual Convention will be the Society's annual business meeting, scheduled for Wednesday morning, October 15. As usual, during the Wednesday morning program, traditional high point of the Convention, the prizes of the Society and its Divisions will be awarded, new officers inducted, and policy addresses presented. The awards will continue through a General Membership Luncheon that noon. The luncheon program, which will be presented by the Department of Conditions of Practice, will feature current controversies in that vital area—engineering education.

The serious side of engineering will not monopolize the entire Convention week, of course. As in other years, the Annual Convention Committee is deep in plans for sightseeing, social events, and entertainment.

The chairman of the Annual Convention Committee, Thomas J. Fratar, reminds prospective Convention visitors that autumn is New York's finest season. Mild, sunny days should enhance the trips to points of engineering interest, of which there are many with New York still enjoying a construction boom.

Naturally wives are being encouraged to attend the Convention too. The Women's Entertainment Committee, headed by Mrs. Fratar, has scheduled fashion shows, tours, and entertainment to the extent that a special program is being printed just for the women. One tour will take them to spots of Colonial and Revolutionary War fame in Westchester County to the north of the city. Tickets will be available for radio and television broadcasts. Visitors wishing to go to the theater are urged to make their reservations well in advance to avoid disappointment. Requests should be sent directly to theater box offices, as listed in the many, readily available listings of Broadway attractions.

Extensive Commercial Exhibits

The outstanding success of the 1957 Civil Engineering Show is responsible for a repeat performance for the 1958 Convention. Expanded to include many more engineering services, products and equipment, this year's Civil Engineering Show will occupy the entire exhibit facilities of the hotel. The show will supplement the technical program in addition to serving as a guide to engineers charged with ordering equipment and supplies.

Full Program Coming

So that members can make detailed plans for attending, the full program for the 1958 Convention will be carried in the September issue of CIVIL ENGINEERING. It is requested that this program be retained for reference, as it will be the only full program sent to each member of the Society.

Early Hotel Reservations Necessary

The Convention Committee urges members to make their plans early to assure themselves the accommodations they want. A large block of rooms has been reserved by the Statler-Hilton for ASCE Convention visitors. Reservations should be sent directly to the hotel, addressed as follows: Reservation Manager, Statler-Hilton Hotel, Seventh Avenue and 32nd Street, New York 1, N. Y.

Annual Convention Committee holds one of many meetings required to assure success of the program planned for next October. Seated, in usual order, are Gardner Reynolds, Mrs. Thomas Fratar, chairman of the Women's Committee; General Convention Chairman Thomas Fratar; and Barclay Johnson. Standing are Joseph Ward, George A. Burpee, Austin Brant, Carl Arenander, Gordon Wallace, John Robinson, Stuart Kirkpatrick, Michael Salgo, Malcolm Pirnie, Jr., and Arthur J. Fox.

Engineering Center Gifts Mount

The United Engineering Center will be a reality in 1960, provided the individual members of our profession meet the challenge and accept the opportunity to make it so. It is both the biggest challenge and the best opportunity that have faced the profession during the past century. The price tag is $10 million, of which ASCE has accepted $800,000 as its share. Ownership and operation of the new building will be vested in the United Engineering Trustees, Inc., by the participating societies.

While it will stand as a symbol of the unity and strength of a proud profession, the 20-story building on United Nations Plaza in New York City is also being designed to serve member engineers the world over effectively and efficiently. It will be functional in character to serve the needs of the profession for another century.

It will house the Engineering Societies Library, long recognized as one of the world's best, and provide the room for the growth required to meet the needs of a rapidly expanding profession. The library will continue to be a public institution, with the best engineering books and periodicals on its shelves and with literature search, translation and photocopy services available promptly to members of the profession by mail as well as by personal visit.

The Center will provide adequate meeting, conference, and board rooms for administrative and task committees, and study groups, extensive enough to enable these vital operations to be more effective. As at present national conventions will be brought to the membership in various cities throughout the country, with the entire program held in convention hotels.

Each Society occupying the United Engineering Center will have its own offices, but some services can be economically centralized such as reproducing, addressing, and mailing. These joint services are being worked out. On the main floor lounges will be provided for the convenience of visitors. There will also be exhibits to inform engineers and the public about the profession. Cafeteria and dining facilities for staff and official visitors also are in the plans.

While only one tower is envisaged initially, it can be expanded horizontally in the future as added floor space is needed without disturbing the occupants.

ASCE's $800,000 share in the Member-Giving Campaign is being raised by individual voluntary contributions under the chairmanship of Enoch R. Needles, Past President of ASCE, with Vice Presidents Francis S. Friel, Norman R. Moore, Waldo G. Bowman, and Samuel B. Morris guiding the effort in their respective Zones. As shown in the bar chart, Fig. 1, the results of the work of the committee are beginning to show, with ASCE pledges approaching $50,000. One of ASCE's active Student Chapters has set a target at which to shoot, a single $50 contribution to unity in the profession of which the students hope soon to be a part.

Organization of the person-to-person solicitation in each Local Section got underway in June, and is designed to reach its peak in the fall.

Each engineer must decide for himself the extent of his once-in-a-lifetime pledge to the United Engineering Center, remembering that payments may be spread over a three-year period and that they are deductible in computing taxable income. For guidance the figures in Table

Student Chapter at Newark College of Engineering is first Chapter to contribute to United Engineering Center.

Newark College of
Engineering
Newark, New Jersey
May 24, 1958

United Engineering Trustees, Inc.
29 W. 39th Street
New York 18, N.Y.

Gentlemen:

I am pleased to inform you that the Student Chapter of the American Society of Civil Engineers at Newark College of Engineering has voted to support the United Engineering Center Building Fund.

It is gratifying to know that the profession to which we aspire has chosen to create a center which will stand as a fitting symbol of the engineers' contribution to society.

As future engineers, we feel that it is a privilege as well as our responsibility to share in achieving this goal. We are therefore sending our contribution of $50.00 along with our best wishes for success in this worthy endeavor.

Sincerely yours,
Alfred G. Kunz
Alfred G. Kunz
President

Greater New York Business Campaign for United Engineering Center gets underway at a luncheon in Waldorf-Astoria Hotel. City officials, admiring model of building, salute the profession and endorse the campaign to raise construction funds. In usual order are John J. Theobold, M. ASCE, deputy mayor; Commissioner Richard C. Patterson of the Department of Commerce and Public Events; William H. Byrne, ASME, chairman, Greater New York Business Campaign; the Hon. Robert F. Wagner, mayor of New York; Abe Stark, president of City Council; and C. F. Preusse, city administrator.

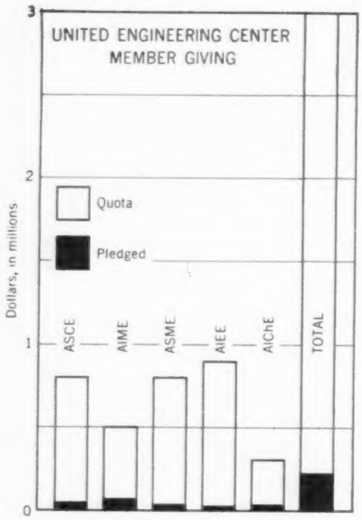


Table I. Range of Giving Needed for Success

Adjusted Gross Income	Suggested Contribution per Year for Three Years	Percent of Gift Absorbed by Government	Annual Cost to Donor
$5,000	$10	22	$ 7.80
6,000	20	22	15.60
7,000	30	22	23.40
8,000	50	22	39.00
10,000	100	26	74.00
15,000	200	30	140.00
20,000	500	34	330.00

I were developed by ASME's Member-Giving Committee, suggesting a range of giving needed for success in financing the Center.

In initiating the ASCE Member-Giving Campaign, Chairman E. R. Needles stated, "When the opportunity comes to make a modest contribution to this great effort by all engineers everywhere throughout our nation, I know that each of you will respond appropriately."

Fig. 1. Status of Member-Giving Campaign for United Engineering Center as of June 17, 1958.

The IABSE—Its Work and Organization

FRANK BARON, M. ASCE, Chairman, U. S. Council, IABSE;
Professor of Civil Engineering, University of California, Berkeley

The International Association for Bridge and Structural Engineering (IABSE) and the Structural and Engineering Mechanics Divisions of ASCE will be co-sponsors of a joint meeting to be held in New York City during the Society's Annual Convention, October 13-17. The Association was formed in Zurich, Switzerland, in October 1929, with representatives of fourteen countries as members and Prof. A. Rohn, of Zurich, as first president. The IABSE grew out of two international conferences—the first held in Zurich in 1926 and the second in Vienna two years later—which revealed the need for a permanent international association dealing with problems in bridge construction and structural engineering and for congresses at regular intervals to discuss the problems.

Headquarters of the IABSE are in Zurich. Prof. F. Stussi, of the Swiss Federal Institute of Technology at Zurich, is president, and Prof. P. Lardy, of the same institution, is general secretary. John I. Parcel, Honorary Member of ASCE and a consulting engineer of St. Louis, Mo., is one of the vice-presidents. The Association's business affairs are handled by an Executive Committee, consisting of the president, vice-presidents, two secretaries, and four technical advisers. This committee is elected by a Permanent Committee, which meets once a year and manages all the other affairs of the association. Each country is represented on the Permanent Committee in proportion to its membership in the IABSE, the delegates from each country being nominated by the managing organization of the IABSE within that country. For the United States the managing organization of the IABSE is the U. S. Council. The U. S. Council meets at least once a year, usually during the ASCE Annual Convention. In addition to the chairman (Professor Baron), the U. S. Council consists of John I. Parcel, Hon. M. ASCE, and J. M. Garrelts, Craig P. Hazelet, Eivind Hognestad, T. C. Kavanagh, R. B. B. Moorman, and T. C. Shedd, all Members ASCE. As secretary-treasurer of the U. S. Council, Prof. Charles M. Antoni, A.M. ASCE, of Syracuse University attends to the general correspondence and collects members' dues.

The aim of the IABSE is to encourage collaboration between the scientists and engineers of different countries, and to provide a medium for the exchange of ideas, of theoretical and practical knowledge, and of the results of research in the structural engineering field. The Association implements this aim by committee activities and by reporting the technical work of its members. Such work is reported in the Congress papers and in the Bulletin and Publications of the IABSE. The Publications and Congress papers form an authoritative reference in analytical, experimental, and design aspects of structural engineering. Construction aspects and news items are covered in the Bulletin.

Each paper is published in one of the official languages of the IABSE—French, German and English—with the title and a summary of each paper given in all three languages. The Publications are issued annually, while the Congress papers appear in preliminary and final form. To date there have been sixteen volumes of the Publications and eight volumes of Congress papers. Most of the volumes may still be obtained from Professor Antoni, who will furnish information on the cost (each has a different price). There is a special low price to subscribing members.

Another function of the IABSE is to serve as a forum for discussion of structural engineering on an international scale. The Congresses, which take place at four-year intervals, have been held in Paris, Liége, Cambridge, Berlin and Lisbon. There has been considerable interest in holding a Congress in the United States. However, it has not been feasible

to do so because of currency restrictions and the high cost of travel that would be involved for most members of the Association. The forthcoming joint meeting of the IABSE and the Structural, and Engineering Mechanics Divisions of ASCE has been planned as a possible solution to the problems involved in an international get-together.

The IABSE now has about 2,500 members distributed among 52 countries. The British Commonwealth and Europe are represented by the largest number of members, and the United States by about 250 members. Membership is on both an individual and collective basis. Membership in ASCE or a comparable technical society automatically satisfies the requirements for individual membership in the IABSE. Collective memberships may be taken out by government organizations, universities, scientific institutes, associations, syndicates, and firms. The fee for individual members is $4.75 and for collective membership $19.75.

Holders of individual membership are entitled to contribute to the Publications and to the Congress papers. They may also participate in the Congress and purchase (practically at cost) one copy each of the volumes and Congress papers still available. Collective membership entitles holders to purchase up to two copies each of the volumes and publications at reduced prices, and to designate two individual staff members as representatives in the work of the Association.

The IABSE seeks to complement the activities of the various technical organizations of each country. It is eager to cooperate with existing agencies in furthering technical knowledge and fostering good will among the professional co-workers of different countries. Membership in both ASCE and IABSE can be of benefit to engineers in each country—first in promoting professional knowledge and second in increasing international understanding and good will. The forthcoming joint meeting of the two societies will be an inspiring example of what our government urges—the collaboration of our scientists and engineers with those of other countries.

More Insurance Benefits For Members

In August will begin the tenth year of the ASCE Group Disability Plan. The Administrators have reported to the Board of Direction that their claim experience again has been good—good enough to warrant further increases in benefits and liberalization of certain underwriting rules with no increase in cost. The increase in benefits and recommended changes approved by the Board after full consideration are as follows:

1. ASCE Group Insurance Program

The title of the entire insurance coverage is changed from "ASCE Group Disability Plan" to "ASCE Group Insurance Program." Since the "Plan" now consists of a number of separate parts, it is more accurate to describe the whole coverage as a "Program," reserving the term "plan" to describe each part of the program.

2. Loss of Time Plan

(*a*) Sickness benefits are increased from a maximum of 2 to a maximum of 3 years for members under age 60. Members over age 60 when disability starts will still be limited to a maximum of two years of sickness benefits.

(*b*) The aviation exclusion clause again is liberalized. The only aviation exceptions are operating, learning to operate, or serving as a member of a crew of any aircraft.

(*c*) Principal sum benefits are increased by 50 percent. For example, certificates of insurance now providing $5,000 principal sum benefits will provide $7,500 principal sum benefits.

(*d*) A member between the ages of 60 and 70 will now be able to apply for $55 weekly indemnity. Heretofore, a member could only apply for $55 weekly indemnity up to age 65 and for $27.50 weekly indemnity up to age 70. Because of this change and because very few members are applying for the $27.50 weekly indemnity option (Plan B), this option has been eliminated from the brochure describing the insurance coverage. The $27.50 weekly indemnity option will continue to be available to Junior Members as Plan BJ.

3. The Major Hospital-Nurse-Surgical Plan

(*a*) The name of this plan has been changed from "Catastrophe-Hospital-Nurse-Surgical Plan" to "Major Hospital-Nurse-Surgical Plan". The term "catastrophe" apparently has been confusing to some members.

(*b*) In the past this plan excluded indemnity for mental illness. As an additional coverage, expenses for mental illness up to $1,500 will be included when the insured is confined in a hospital.

(*c*) Coverage will be continued if a member retires from active practice, as long as he remains a member of the Society, until the premium due date after he reaches 70. Previous coverage terminated when a member retired.

4. The Senior Hospital and Surgical Plan

(*a*) This coverage is extended to an eligible spouse of a member at a premium of $80 per year. The annual premium for a member is $60.

(*b*) Since applications for the Major Hospital-Nurse-Surgical Plan (paragraph 3 above) are limited to families where the member is under the age of 60, applications for the Senior Hospital and Surgical Plan will be considered from members and their spouses when the member is between ages 60 and 70.

5. Optional Hospital and Surgical Coverage

(*a*) This optional coverage has been available with the Loss of Time Plan (paragraph 2 above) for several years. Since the Major Hospital Nurse-Surgical Plan became available applications during the past year for coverage under the Optional Hospital and Surgical Plan have dropped to 36 as compared to 1,000 for the major Hospital-Nurse-Surgical Plan. The Optional Hospital and Surgical coverage, however, has provided a means of obtaining hospital and surgical coverage for members over age 60 who could not apply for the major Hospital-Nurse-Surgical Plan.

Now that the Senior Hospital and Surgical Plan is available to members over age 60 the Optional Hospital and Surgical Plan will no longer be offered to new applicants. Members who already carry this coverage may continue to do so.

6. Two-Year Incontestability Clause

All certificates issued under the ASCE Group Insurance Program will provide that after a two-year period the company cannot contend that an insured had concealed information in making application or coverage. While this has not been a problem in connection with the Insurance Program, the Board felt that such a clause would be of benefit to the insured.

Mystery of the Missing Mural

In the Engineering Societies' Library, at Society headquarters, a mystery slowly is being unraveled. The mystery was this: Whatever became of the magnificent mural depicting the engineering profession which, up until 30 years ago, hung on the east wall of the Library, covering an area of about 23 by 12 ft?

The work of the celebrated painter, F. Dana Marsh, who was called the "engineer's artist," the mural was installed on the Library wall sometime in 1911. In its issue of September 17 of that year, the *New York Herald* (now the *Herald-Tribune*) devoted a full page to the engineering paintings of Mr. Marsh. Referring to the mural, which was entitled "Engineering," the newspaper's art critic said: "It occupies a conspicuous space in the library and is just above the bust of Andrew Carnegie. It might be called the epic of the steel age."

But apparently about 1927 or 1928, the mural mysteriously vanished from the Library wall. Only a few pencilled notes could be found in the files indicating that the painting was removed "either in '27 or '28," and no records could be located as to why it was taken down. No one could be found in the entire Engineering Societies Building who was around in the late '20's, or who, if so, remembered what had happened to the painting. It was obvious that this was a job for some fine detective work, so a team of Library and ASCE sleuths (amateur variety) went to work on the case.

They found out first of all that there was an artist by the name of F. Dana Marsh, and a very celebrated one, indeed. Also, that he was still living in Ormond Beach, Fla., and active at the age of 86.

Since he was going to Florida anyway on a vacation trip, "Sleuth" James M. Lessley, assistant librarian, was assigned to find out the facts from Artist Marsh. It seems that the building management had asked the artist to take down the mural, painted on canvas, to make way for some new construction. Six laborers were assigned to the task of removing the mural, which had been glued directly upon the brick walls. Apparently they did not all work in unison, for when one of the workmen pulled too hard, some of the bricks became dislodged. The weight of the bricks pulled the mural to the floor in shreds. It was so badly damaged that the painter burned the pieces.

Oddly enough, there is no record that there was any major construction work on the Engineering Societies Building in 1927 or 1928. It is speculated that the construction work involved may have been ten years earlier, when three floors were added to the building to accommodate ASCE's headquarters, despite the pencilled notation that the painting was removed about '27 or '28.

Those who have studied pictures of the mural, reproduced on this page, regard the destruction of the painting as a tragic loss. There are those who would like to see it duplicated, and hung in the new United Engineering Center, for which contributions are now being solicited from the members and friends of the five Founder Societies and other engineering groups.

In its 1911 article, the *New York Herald* had this to say about the painting:

"In 'Engineering' are seen ponderous tools suggesting, in their handling, the dominant characteristic of great activity tackling the rough business of the world. All this on a rocky foreground. In the center of the mural . . . are the engineer-in-chief and other leaders. . . . To the left, with field glasses, is the consulting engineer, and heaving up the rocks is a group of pneumatic drills, the tools that make possible the mine and the tunnel. . . . To the right of the central group a gang of brawny men are hoisting a dynamo from its skids. One man pulls down a huge hook and chain from the chain block; others swing into place the crane to which the block is fastened. Silhouetted against the sky are seen blast furnaces, bridges flung over rivers and, piercing the sky, the tall towers of an American city—feats of engineering all; and each one of them a stanza in the great epic of the age of steel."

Across the top of the mural is the following legend, which is attributed to Henry G. Stott, 1910-1911 president of the United Engineering Trustees and a trustee for many years. "Engineering—the art of organizing and directing men and of controlling the forces and materials of nature for the benefit of the human race."

Division Doings

Joint ASCE-IABSE Meeting

A unique opportunity to meet and hear some of the world's leading authorities on the design and behavior of structures and properties of materials will be provided during the Society's Annual Convention in New York this October. The result of two years of planning by members of ASCE and the U.S. Council of IABSE, the meeting will cover a wide range of topics in steel and concrete properties, design, and research.

Eight stimulating half-day sessions have been arranged to give a well-rounded picture of current research developments and practice in Europe and the United States. The joint program is being arranged by the Structural and Engineering Mechanics Divisions and the U.S. Council of the International Association for Bridge and Structural Engineering. The ASCE Construction Division will also join in co-sponsoring the **Thursday afternoon** and **Friday morning** sessions. The joint program has been made possible by a grant from the National Science Foundation and other contributions from organizations and individuals.

The opening topic, set for **Monday morning, October 13,** will be "Plasticity in Steel." Research and design aspects will be discussed by John F. Baker, professor and head of the Department of Engineering at Cambridge University; Lynn S. Beedle, research professor at Lehigh University; and Daniel C. Drucker, chairman of the Division of Engineering at Brown University. The **Monday afternoon** subject will be "Ultimate Strength in Reinforced Concrete and Folded Plate Structures." The speakers are Eivind Hognestad, manager of the Structural Development Section of the Portland Cement Association; A. L. L. Baker, professor of concrete technology at the University of London; and Charles S. Whitney, partner in the New York City consulting firm of Ammann & Whitney.

Tuesday morning, October 14, will be devoted to "Model and Analytical Research—Dams and Shells." In this session Alfred L. Parme, manager of the Structural and Railways Bureau of the Portland Cement Association, will discuss "Application of Shell Theory to Arch Dams." The rest of the panel will consist of distinguished foreign engineers: Prof. Guido Oberti, of the Polytechnic School of Turin and manager of the Experimental Institute for Models and Structures, Bergamo, Italy; P. Lardy, professor of masonry construction at the Zurich Institute of Technology; and A. M. Haas, professor of concrete and concrete construction at the Delft (Holland) Institute of Technology.

"Research in Dynamics and Fatigue of Metals" is the scheduled topic for **Tuesday afternoon.** The speakers will be George S. Vincent, of the Division of Physical Research in the U.S. Bureau of Public Roads; George W. Housner, professor of applied mechanics at California Institute of Technology; Nathan M. Newmark, professor and head of the Department of Civil Engineering at the University of Illinois; and F. Stussi, president of the IABSE and professor at the Zurich Institute of Technology.

The program planned for **Thursday morning, October 16,** will treat the topic, "Stability Considerations in Metal Structures." The speakers' panel will consist of C. Massonnet, professor of theoretical and applied mechanics at the University of Liége; Bruno Thürlimann, associate professor of civil engineering at Lehigh University; and George Wastlund, technical adviser to the IABSE and professor of bridge building and structural engineering at the Royal Institute of Technology, Stockholm.

A number of interesting papers are planned for **Thursday afternoon,** which will be devoted to "Prestressed Concrete and Concrete Bridges." The authors are Yves Guyon, technical director of the Technical Society for the Use of Prestressing (Paris); Frederick S. Snow, consulting engineer of London; T. Y. Lin, professor of civil engineering at the University of California; and Hubert Rüsch, professor at the Munich Institute of Technology.

"Steel Bridges and Building Frames," the subject planned for **Friday morning, October 17,** will be discussed by four engineers: Sven O. Asplund, professor of structural mechanics at Chalmers University, Gothenburg, Sweden; E. L. Durkee, Director of ASCE and engineer of erection on Fabricated Steel Construction for the Bethlehem Steel Co.; C. F. Kollbrunner, auditor for IABSE, Zurich; and Thomas C. Kavanagh, partner in the New York firm of Praeger-Kavanagh Engineers. Shell structures will occupy the final, **Friday afternoon,** session. The speakers will be Nicolas Esquillan, technical director of Boussiron Enterprises, Paris; Mario Salvadori and Hans H. Bleich, professors of civil engineering at Columbia University; and Anton Tedesko, vice president of the Roberts and Schaefer Co., New York.

In addition to the technical program, there will be a luncheon on **Tuesday,** where members will have a chance to become acquainted with the distinguished foreign engineers they will hear. The committee in charge of the joint program needs to know how many are planning to attend both the stimulating technical sessions and the Tuesday luncheon. For convenience in notifying the committee a coupon has been provided in the advertising section.

New member-service activities are planned by the Sanitary Engineering Division's Executive Committee during its recent meeting in Memphis. Vice-Chairman Ray E. Lawrence and Board Contact Member Howard F. Peckworth give close attention to the conduct of business by Chairman Richard Kennedy. Others with a finger in the planning are Don P. Reynolds, Arthur D. Caster, Richard Hazen, and Lewis A. Young.

"Seven Wonders" Plaque for Colorado River Aqueduct

Unveiling of plaque honoring the Colorado River Aqueduct as one of the "Seven Civil Engineering Wonders of the United States" took place at special ceremonies held in Los Angeles recently. Here Joseph Jensen (left), board chairman of the Metropolitan Water District of Southern California; Robert B. Diemer, chief engineer and general manager of the District; and ASCE President Louis R. Howson prepare to drink a toast (in water, of course) to the aqueduct. At the time of its selection by ASCE as one of the Seven Wonders, the Aqueduct was cited as the "longest man-made conduit."

Washington Award Goes TO ASCE Honorary Member

Ben Moreell, Honorary Member of ASCE and chairman of the Board of the Jones & Laughlin Steel Corporation, is this year's winner of the Washington Award. The award is given annually to "an engineer by fellow-engineers for accomplishments which preeminently promote the happiness, comfort and well-being of humanity." It is administered by the Western Society of Engineers on recommendation of a commission representing the four Founder Societies.

In nearly thirty years of naval service, Ben Moreell rose from the ranks to become one of the few non-Annapolis graduates to attain the permanent rank of Admiral. From the end of World War I until 1937, when he was appointed Chief of the Bureau of Yards and Docks and Chief of Navy Civil Engineers, Admiral Moreell distinguished himself in building Naval bases and stations all over the world. One of his most important contributions in World War II was his development of the Sea Bees. The Sea Bees were responsible for building and maintaining more than 900 bases and stations essential to winning the war. Upon his retirement from active service in 1946, Admiral Moreell channeled his energies into directing the Jones & Laughlin Corporation, where he launched a $500,000,000 expansion program.

Admiral Moreell was cited by the Washington Award Commission "for distinguished service as a skilled engineer, outstanding naval officer, industrialist, Christian layman, and Hoover Commission associate." Presentation of the award to him took place at a dinner given by the Western Society of Engineers in Chicago on May 9.

ASCE Membership as of June 9, 1958

Members	9,978
Associate Members	13,834
Junior Members	17,230
Affiliates	76
Honorary Members	44
Total	41,162
(June 10, 1957	39,712)

Howard University Host to Student Conference

Maryland-District of Columbia Conference of Student Chapters holds its 1958 spring meeting at Howard University. Participating groups include the Chapters at Catholic University, George Washington University, Johns Hopkins University, the University of Maryland, and Howard University.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.11
Boston	1.15	1.13
Chicago	1.30	1.26
Denver	1.22	1.19
Houston	1.12	1.08
Kansas City	1.14	1.14
Los Angeles	1.16	1.16
New York	1.20	1.17
Pittsburgh	1.05	0.93
Portland (Ore.)	1.15	1.15
San Francisco	1.19	1.17
Seattle	1.06	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.91	0.85
II, Mid. Atlantic	1.17	1.17
III, Mid. West	1.25	1.15
IV, South	1.09	1.07
V, West	1.00	0.97
VI, Far West	1.15	1.15

Figures are based on salaries in effect as of May 15, 1958. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

In its annual recognition of student achievement, the **Central Illinois Section** honored three University of Illinois civil engineering seniors at its May meeting. The winners were Robert Malherek, Charles W. Petzold, and Richard C. Capek. The awards consist of a certificate, a junior badge, and payment of the entrance fee as a Junior Member of the Society. Prof. Ivan King, of the University of Illinois, presented a fascinating lecture on "The Stars—Whence and Whither." His discussion of the origin and evolution of the stars was followed by an active question-and-answer period.

Society affairs held the spotlight as members of the **Central Pennsylvania Branch** of the **Philadelphia Section** heard ASCE Director E. L. Durkee discuss recent Society activities at the annual meeting. Student prize papers prepared jointly by Richard C. Tennent and Ronald J. Fisher, of Bucknell University, and by Jorge Elqueta and Fernano A. Barata, of Pennsylvania State University, were read. Section officers for coming year were elected, and the slate is as follows: Fred L. Morgenthaler, Jr., president; Robert H. Klucher, vice president; and Hugh B. Henry, secretary-treasurer.

Practicing engineering unity, the **Cincinnati Section** recently participated in a joint meeting with the Society of American Military Engineers and the American Institute of Electrical Engineers. The evening meeting was presided over by Section President Ray Raneri. Martin W. Oettershagen, deputy administrator for the St. Lawrence Seaway Development Corporation, was guest speaker, with an illustrated lecture on "The Greatest Construction Show on Earth." He also showed the corporation's official film, "The Eighth Sea."

Spanning two thousand years in their program, "Earth Measurements—B.C. to I.G.Y.," members of the Student Chapter at the Georgia Institute of Technology entertained and educated members of the **Georgia Section** at the May meeting. Section President Carl Kindsvater presided and turned the meeting over to Bobby Cox, Student Chapter president. John W. Fortune, moderator, introduced Alfred D. Evans who treated ancient standards and instruments up through the fifteenth century. Carrying the thread of history forward, Floyd E. Hardy continued with a description of events up to the present, and Frederick B. Higgins kept things current with a discussion of instruments developed since the perfection of photogrammetry. The program was received enthusiastically by the Section.

Testing **Hawaii Section** members' memories of their college mathematics, the Student Chapter of the University of Hawaii presented talks and demonstrations on thin shell construction at the Section's May meeting. As guests of the Student Chapter, Section members attended a dinner-meeting and then saw the demonstrations. Stanley T. Doi, recipient of the Section's annual prize for outstanding senior, was awarded $50 and a year's Junior Membership in the Society. Brig. Gen. E. I. Davis, of the Army Engineer Division, Pacific Ocean, received the Section's monthly citation as "Engineer of the Month."

A combination of students and Sputniks made a lively May meeting for the members of the **Kansas Section.** Students from the Student Chapters at Kansas State College and the University of Kansas were introduced to the members prior to presentation of awards to outstanding seniors. The winners are Carlos M. Campuzano, of the University of Kansas, and Lawrence A. English, of Kansas State College. Each received a certificate, a Junior Member badge, and payment of his entrance fee as Junior Member in the Society. Charters were presented to the two Student Chapter presidents. Prof. Phillip G. Kirmser, of the Department of Applied Mechanics at Kansas State College, spoke on "Sputniking." Professor Kirmser showed drawings and pictures to illustrate his discussion of tracking satellites by photographic methods.

The proposed changes in ASCE member grades were discussed by ASCE Director E. L. Durkee at the **Lehigh Valley Section's** May meeting. Action to create a Central Pennsylvania Section was endorsed by the members. Featured speaker of the evening was Kramer J. Schatzlein, Jr., chemical engineer with the Lehigh Portland Cement Company. Mr. Schatzlein explained the processes being used at the company's new cement plant in Bunnell, Fla., which uses coquina deposits instead of limestone for raw material.

A challenge to engineers to solve the local rapid transit problem was offered to members of the **Los Angeles Section** at their May meeting by Ralph P. Merritt, executive director of the Los Angeles Metropolitan Transit Authority. Mr. Merritt challenged the group to design a mass rapid transit system involving vehicles *other than* buses, street cars, subways, or monorails. He said the solution is up to engineers. At a recent meeting honoring ASCE President Louis R. Howson, the Section presented the 1957 James Laurie Prize to co-winner Walter L. Dickey. Mr. Dickey, a structural engineer for the Wailes Precast Concrete Corporation in Sun Valley, Calif., was unable to attend the Annual Convention in New York last October, when the other Society prizes were presented.

With nothing more serious on their

G. Brooks Earnest Award of Junior Membership in ASCE was won this year by Case Institute of Technology senior Richard D. McKeon. Award was made at May meeting of Fenn College Student Chapter of ASCE, at which Fenn civil engineers were host to members of Case Student Chapter and Cleveland Section. Pictured, left to right, are G. Brooks Earnest, president of Fenn College; Craig P. Hazelet, Director of ASCE; Mr. McKeon; and Dr. George E. Barnes, professor of hydraulic and sanitary engineering at Case. At same meeting, the Cleveland Section presented Junior Membership awards to Fenn student Howard Gacsi and Case student Joel Roth.

Colorado Section members heard Elsie Eaves, business news manager of "Engineering News-Record," speak at annual awards dinner, when certificates were presented to outstanding seniors from Student Chapters. In photo at left, Miss Eaves is flanked by Clarence L. Eckel (left), Director of ASCE and dean at the University of Colorado, and E. S. Ellett, president of Colorado Section.

L. W. Bremser (right) president of Kansas City Section, greets Lt. Col. W. E. Paxton, of Future Weapons Branch Plans Division, Strategic Air Command, headquarters, Offutt Air Force Base, Nebr., who addressed the Section on Strategic Air Command in the Missile Age.

minds than having fun, members of the **Maryland Section** met in May for their annual entertainment. Prefacing the gaiety, President Albert L. Grubb named a committee to head the Maryland fund drive for the new Engineering Building. Members were treated to a concert by the Johns Hopkins Glee Club and to a program of hypnotism and mesmerism presented by Frank Sazama.

Members of the **Miami Section** recently heard two speakers relate new inventions to the field of civil engineering. John Finnel, of IBM, spoke on "Uses of Digital Computers in Civil Engineering," with emphasis on applications in highway engineering. Prof. Willard Hubbell, chairman of the Engineering Graphics Department at the University of Miami, spoke on the "McIlroy Fluid Network Analyzer" and described some actual engineering applications.

Planning for the future at their May meeting, members of the **National Capital Section** pondered recommendations for possible improvements in the Section organization and meetings. The following new slate of officers was unanimously elected: Alfred R. Golzé, president; W. O. Hiltabidle, vice president; D. P. Jenny, secretary; and John Heckathorn, treasurer.

The Nebraska Section will have a chance to be host to an ASCE Convention in Omaha in 1962, president K. B. Lucas announced at a recent meeting. Members heard two enlightening talks by men well-versed in their fields. Gunnar M. Brune, engineering geologist with the Engineering and Watershed Planning Unit of the Soil Conservation Service at Fort Worth, Tex., spoke on "Geologic Investigations of Dam Sites by the Soil Conservation Service." His talk included a description of the various types of equipment used. P. T. Benedict, head of design and construction for the Soil Conservation Service at Fort Worth, read a paper on "Hydraulic and Structural Performance of Flood Prevention Works During 1957 Spring Floods in Texas, Oklahoma, and Arkansas."

Students from the North Dakota State School at Fargo were honored by the **Northwestern Section** at its May meeting for outstanding work in engineering studies. First prize went to Robert D. Hanson. The featured speaker was Norman Moore, ASCE Vice President and chief of the engineering division, Lower Mississippi River Commission at Vicksburg. After commenting on professional aspects of ASCE, Mr. Moore gave an illustrated lecture on engineering on the Lower Mississippi.

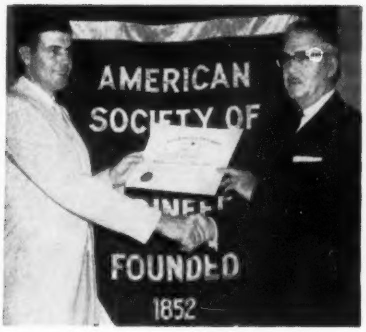
There has been a change in the officers of the **Republic of Colombia Section,** due to an honor bestowed upon the former vice president, Dr. José Gomez Pinzon, who has been appointed Colombian Ambassador to Germany. As a result of changes,' officers are now: Alfredo D. Bateman, president; Carlos S. Ospina, vice president; Carlos Tamayo, secretary; and Hans-Peter Jacobsen, treasurer.

Projects of the Student Chapter at the University of Rhode Island were on display for members of the **Rhode Island Section** at their May meeting. Of especial interest was a large working model of Narragansett Bay. The guest speaker was Waldo G. Bowman, ASCE Vice President and editor of *Engineering News-Record.* Newly elected officers are: Harold Bateson, chairman; Fenton G. Keyes, vice chairman; John Graas, secretary; and Charles N. Bissell, treasurer.

Recently the Junior Member Forum of the **Sacramento Section** had the opportunity to tour the Calveras Cement Plant at San Andreas, Calif. In the morning, Calveras engineers escorted members through the quarry sites. Luncheon was served at the famous Kentucky House, courtesy of the company. The afternoon was spent touring the wet process cement plant.

New heads of the **Southern Idaho Section** are: M. B. Austin, president; C. H. Studebaker, first vice president; H. D. Hafterson, secretary; and K. E. Anderson, treasurer.

The joint spring meeting of the **Texas and Louisiana Sections,** held at Beaumont in May, was hailed as a great success by all. Hosts to the joint group were the Texas Section's **Southeast** and **San**



Mason Nevill (left), president of Student Chapter at Texas Agricultural & Mechanical College, receives charter for Chapter from ASCE Director Randle B. Alexander.

Jacinto Branches. Luther Beale and Noble Jones, the general chairmen, were aided by Louisiana Section President Bernard A. Grehan and a host of committeemen. The attendance of 250 included ASCE President Louis R. Howson, Past President Mason Lockwood, Vice President Samuel Morris, and Director Randle B. Alexander. The keynote address, delivered by Mr. Lockwood, reiterated the theme of the meeting, "Unity in Engineering." Unified action is absolutely essential to the further development of the profession, Mr. Lockwood emphasized. In a preliminary competition for this year's Daniel W. Mead Junior Member Prize Entry from the Section, the paper by D. R. Van Sickle, of the Houston Branch, was chosen. A paper on "Rammed Earth Construction," by Jim Abernathy of the University of Texas, took first place in the Section's annual student paper competition. The Section's Life Member awards were made at the Friday luncheon to veteran engineers Herman Larsen and T. A. Munson.

Little-known fields in which the sanitary engineer can do important work were discussed at the **Tri-City Section's** April meeting when members heard Al Stefen speak on sanitary engineering in industry. Rodent and insect control are two of these fields. In May, members heard a talk on the role of photogrammetry in the National Highway Program. Speaker Paul Summerfelt discussed reservoir and dam site locations.

Lively discussion at a recent **Wisconsin Section** meeting resulted from a controversial paper entitled "The Retrogression of Civil Engineering as a Profession." Fomenter of the discussion was speaker Alvan C. Fromherz.

Presidential responsibility changes hands at Philadelphia Section meeting, honoring ASCE President Louis R. Howson. Shown here (left to right) are: Mr. Howson; retiring Section president J. H. Ferguson; ASCE Vice President Francis S. Friel; and incoming Section president H. B. Vaughan, Jr., receiving the gavel.

ASCE CONVENTIONS

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 13-17, 1958

LOS ANGELES CONVENTION
Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

CLEVELAND CONVENTION
Cleveland, Ohio
Hotel Cleveland
May 4-8, 1959

TECHNICAL DIVISION MEETINGS

HYDRAULICS CONFERENCE
Atlanta, Ga.
Georgia Institute of Technology
August 20-22
Sponsored by
ASCE Hydraulics Division
ASCE Georgia Section
Georgia Institute of Technology

IRRIGATION AND DRAINAGE CONFERENCE
Memphis, Tenn.
September 25-27
Sponsored by
ASCE Irrigation and Drainage Division

CONFERENCE ON ELECTRONIC COMPUTATION
Kansas City, Mo.
Continental Hotel
November 20-21
Sponsored by
ASCE Structural Division
Kansas City Section

LOCAL SECTION MEETINGS

Virginia—Norfolk Branch meeting the third Monday of every month at 12 noon in the YMCA Cafeteria; Richmond Branch meeting the first Monday of every month at 12:15 p.m. in the Hot Shoppe Cafeteria; Roanoke Branch meeting the second Wednesday of every month at 6:30 p.m. in the S & W Cafeteria.

South Carolina—Annual summer meeting at the Fort Sumter Hotel in Charleston, S. C., August 1 and 2.

Texas—Fall meeting in San Antonio, September 25-27. Austin Branch dinner meeting at the Engineers and Associates Club, July 17 at 6:30 p.m.

For easy erection and availability

you can count on USS Structural Steel

When you want to erect a bridge in a hurry, it pays to use a familiar, easy-to-work-with material. Can you think of anything that fills the bill as well as *steel?*

For decades, bridge-builders have preferred steel because it's so easy to punch, shear, hot-work, weld, flame-cut, rivet or bolt—and because it can be shop-fabricated and erected in practically any kind of weather. And today, the new High Strength and Alloy Steels allow weight-saving, labor-saving designs that have revolutionized the bridgebuilding art.

And here's the best news: Long before the Interstate Highways Program was suggested, the steel industry was planning new facilities to produce more structural shapes and plates. Some of these new facilities are already in production, and others will follow quickly. They assure you an adequate supply of structural steel whenever and wherever you may need it.

For proven dependability, for simplicity of design, for easy erection, for *availability—you can count on steel.*

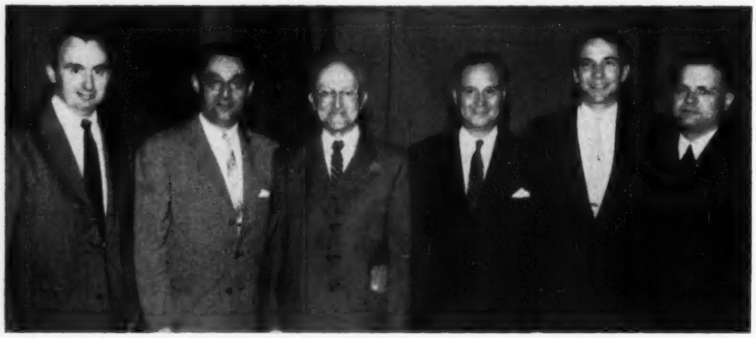
USS
TRADEMARK

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

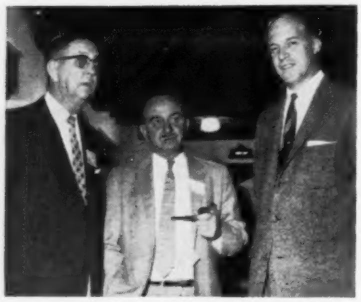
KEEP OUR ROADS ON THE GO

In upper view Retiring Section President Roger Gilman congratulates O. H. Ammann, Honorary Member of ASCE and famous bridge engineer, on his selection by the Section as "Metropolitan Civil Engineer of the Year." This award is made annually for "the most outstanding service to the metropolitan area." Designer of the George Washington Bridge, Mr. Ammann is currently design consultant for the second deck of that famous structure. He is also design consultant for the Narrows Bridge, to be constructed between Brooklyn and Staten Island and the Throgg's Neck Bridge in Queens. In lower view, Mr. Gilman presents Section award to William J. Shea in grateful recognition of his long service as secretary-treasurer of the Metropolitan Section.



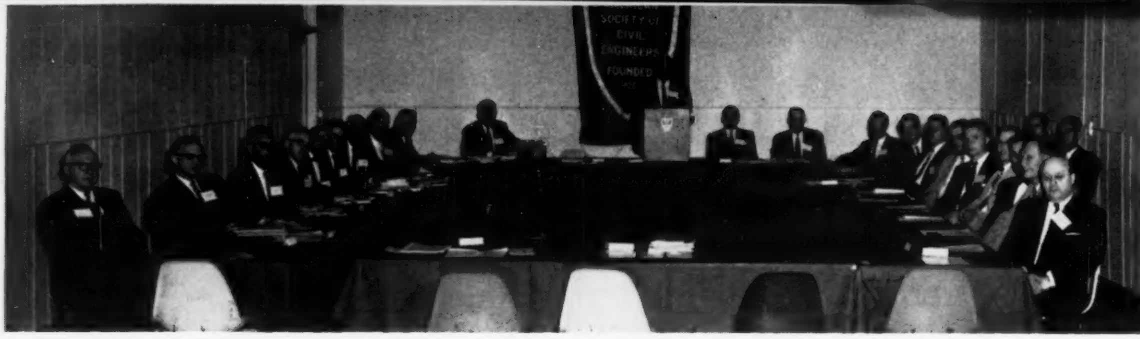
Metropolitan Section slate for forthcoming year, elected at meeting on May 21, is shown here. Officers are, in usual order, Arthur J. Fox, Jr., director; Michael Salgo, vice president; W. J. Shea, treasurer; Richard Tatlow III, president; R. H. Dodds, vice president; and Brother Austin Barry, secretary. New Section directors, in addition to Mr. Fox, are Stanley M. Dore and Irvine P. Gould.

Toledo Section President A. Alfred Picardi, presents Student Chapter charter to Chapter officers at University of Toledo. Shown with Mr. Picardi, in usual order, are W. C. Achinger, treasurer; Jerry Frederick, vice president; Felix Sampago, secretary; and Frank Pollauf, president.



Guests at New Mexico Section's annual spring meeting chat with one of the speakers, Dutton Briggs, structural engineer for the Portland Cement Association. Shown, left to right, are Miles Britelle, president, New Mexico Chapter, American Institute of Architects; Rube Cole, president, New Mexico Section; and Mr. Briggs. The meeting topic was "Recent Developments in Concrete Construction."

Special honors were awarded to outstanding engineering students from Duke University and North Carolina State College at annual spring meeting of North Carolina Section. Winners shown here are (left to right): H. L. Blackburn, Jr., Duke; B. T. Smith, Mrs. Colleen B. Garrison, E. J. Poindexter, all of N. C. State College; G. L. Van Schoick, Duke; and M. L. Carroll, N. C. State College. Mr. Smith received the annual award of the Carolinas Branch of AGC, for outstanding senior work in construction. Messrs. Carroll and Van Schoick presented prize-winning papers at the meeting, and the other students received Section awards for general excellence in their college work.



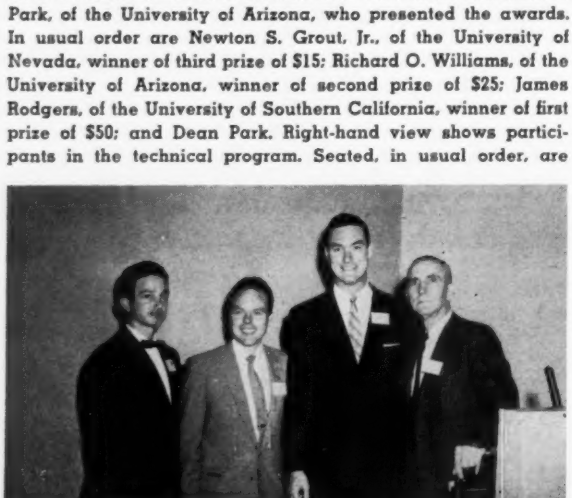
District 10 Council Has Tenth Annual Meeting in Atlanta

District 10 Council is seen in action at its recent tenth annual meeting held in Atlanta, with the Georgia Section as host. The two-day session, which dealt with a wide range of ASCE business at local level, was described as "exceptionally productive" by the delegates attending. ASCE was represented by Vice President Francis S. Friel, of Zone II, and Director Don Mattern. Official attendance from the eight Sections was augmented by a number of Section officers, past and present, and by members from Branches within the Sections. Warren S. Mann was Council chairman, and Burton J. Bell, secretary-treasurer. The North Carolina Section will be host to the 1959 Council meeting, and James Pou, of Charlotte, will be 1959 chairman.

Eleventh Annual Conference of Pacific Southwest Council Guest of Arizona Section in Phoenix, April 17-19

ASCE President Louis R. Howson (at right) presents 1957 Moisseiff Award to David J. Peery, on leave from the University of Michigan with HRB San Diego Laboratories. Professor Peery was unable to attend the presentation ceremonies in New York last October. Over 300 attended the Council conference.

One of the pleasant features of the Pacific Southwest Council's annual conferences is the presentation of student prizes for the best papers. Winners in the recent Eleventh Annual Conference, held in Phoenix, are shown in left-hand view with Dean John C. Park, of the University of Arizona, who presented the awards. In usual order are Newton S. Grout, Jr., of the University of Nevada, winner of third prize of $15; Richard O. Williams, of the University of Arizona, winner of second prize of $25; James Rodgers, of the University of Southern California, winner of first prize of $50; and Dean Park. Right-hand view shows participants in the technical program. Seated, in usual order, are Paul Baumann, assistant chief engineer of the Los Angeles County Flood Control District; M. J. Shelton, chairman of ASCE Committee on Engineering Education; Prof. A. W. Ross, of the University of Arizona; and R. Glen Ryden, chief computer of the Arizona State Highway Department. Standing are Prof. R. D. Kersten, of Arizona State College; Greer W. Ferver, consulting engineer of San Diego; K. W. Lange, district sales manager for Chicago Bridge and Iron Works, Houston, Tex.; P. H. McGauhey, director of sanitary engineering research at the University of California; Russell C. Collmer, computer systems analyst for General Electric; and Eugene Zwoyer, consulting engineer.



Asphalt pavement water-proofs 93% of

water-rich Oregon's heavy-duty highways

Oregon's growing . . . and fast!

In the luxuriant Willamette Valley of the Beaver State, there's plenty of water for industry and agriculture . . . and a marvelous network of Asphalt highways.

Long ago, the state's engineers learned how to build economical road structures that stand up in country with heavy rainfall. They use a carefully stabilized and well-drained base "roofed" with modern heavy-duty Asphalt paving.

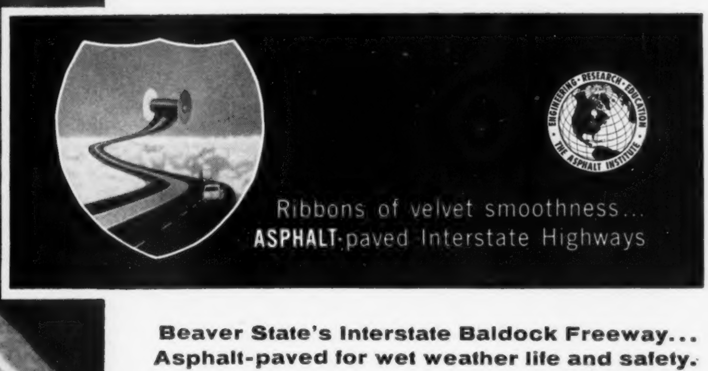
6,594 of Oregon's 7,031 miles of heavy-duty highway are Asphalt-paved.

Asphalt pavements like these are reputation builders. They cost less to build . . . 10% and sometimes up to 50% less*. They cost less to maintain . . . no spalling, adjust to settling, quick repair, less traffic painting needed. They cost less to modernize . . . widen them, strengthen them as you like, construction costs stay low.

The lower costs of Asphalt paving, both initially and annually, stretch highway funds . . . put more money at your disposal to increase your state's highway network, to boost state growth, to improve local roads.

Build *your* reputation on the permanence, the comfort, the safety of durable Asphalt paving.

THE ASPHALT INSTITUTE
Asphalt Institute Building, College Park, Maryland



Beaver State's Interstate Baldock Freeway... Asphalt-paved for wet weather life and safety.

It has been made part (U.S. 5) of the National System of Interstate and Defense Highways. It runs 37.05 miles between Portland and Salem, Oregon. Noteworthy for low cost (despite location over troublesome soil) and built-in safety (gentle curves, headlight screening).

**Saves from $11,768 to $92,628 per mile. Write for details.*

BY-LINE WASHINGTON . . . . .

Some 30,000 professional engineers are dues-paying members of labor unions, the National Society of Professional Engineers says in a study released last month. This is somewhat less than 10 percent of the total engineering population of the country. NSPE's tabulation of labor organizations includes several which claim to have some civil engineering representation.

* * *

Dedication of a new headquarters building here for the Associated General Contractors of America was the occasion for several engineering writers to predict what construction would be in the Year 2000. Among other things, the crystal-ball gazers foresaw that automobiles would be banned from central cores of large American cities and existing traffic lanes converted to parks; that there would be lots more prefabrication in building construction; that on-site jobs would be accomplished by automatic machines directed from remote-control stations; that engineers would be designing separate highways for express buses; that airfields would be built as almost complete cities to provide for a tremendous increase in air travel; that automatic refuse collection would revolutionize the design of municipal sewage systems; and that future highways would have built-in electronic devices to control traffic flow and vehicle operation.

The AGC also last month released the results of a survey of construction prospects around the country. The preponderance of replies from the association's 125 chapters revealed that over-all construction volume is holding up well enough through the recession period.

* * *

Engineers in Uncle Sam's employ are getting a 10 percent pay raise under a bill just signed by President Eisenhower. Several thousand civil engineers working for the Bureau of Public Roads, the Bureau of Reclamation, the Corps of Engineers, and other agencies will be benefitted. The new salary schedule comes on top of one granted these men a few months ago when the Civil Service Commission was given permission to push engineers to the top of their grade, pay-wise.

The measure also created several hundred new "superpay" jobs, ranging from $14,190 to $17,500, for which a certain number of engineers will undoubtedly qualify. And it permits the federal government to offer new engineers substantially higher starting salaries.

* * *

The House has passed and a Senate committee is now considering a bill which would change the name of the Navy's 116-year-old Bureau of Yards and Docks to "The Bureau of Civil Engineering."

* * *

A quick review of engineering construction bills pending as of this writing reveals measures in this status:

Congressmen in both chambers have written compromise *Rivers and Harbors* bills which they hope will be satisfactory to the Administration. President Eisenhower vetoed the huge omnibus measure ($1.5 billion) passed by Congress earlier this session, the second time in a row he has, by veto, protested the inclusion of projects not yet found feasible.

The big $2-billion *Public Works* bill has been reported out of the House Appropriations Committee with $16 million in it for 40 new Corps of Engineers starts. It involves $800 million worth of construction. The Administration is likely to be unhappy with this feature. It wants to hold the lid on new starts.

Hearings have been completed on two other big money bills creating long-range construction programs. One is for the *Federal-Aid Airport* program, which Congressional promoters would like to see boosted to $100 million a year. The other is the *Water Pollution Control* program, which advocates want increased from the current $50 million a year to $100 million.

The Administration has testified against both, on the grounds that these are programs for which the states and local governments might better assume responsibility, rather than the federal government.

Congressmen are feuding with the White House still over the size of the budget for new atomic plant construction and equipment. The Administration submitted a request for $193 million for fiscal year 1959. Some legislators are talking about doubling the amount. This highly controversial subject moves constantly in circles. There is disagreement over design, location of the plants and responsibility. Periodically the whole subject becomes bogged down in a discussion of public vs. private power development. But the subject is one of interest to civil engineers because each new plant poses new problems in design and technology, when they finally do reach the construction stage.

* * *

The resignation of Admiral Lewis L. Strauss as chairman of the Atomic Energy Commission has been accepted by President Eisenhower. John McCone, president of the Joshua Hendy Corporation of Los Angeles, Calif., has been named to the Commission to fill the vacancy. The chairmanship has not been filled.

* * *

The first application of an atomic bomb explosion to construction work may soon be forthcoming. The Atomic Energy Commission has reported it may touch off a nuclear explosion to dig a harbor in northwest Alaska. An underground explosion in Nevada last year indicated that huge earthmoving jobs might be safely attempted by nuclear fission.

Engineers have been assigned to study the feasibility of the Alaska port so that large-scale mineral deposits just inside the Arctic Circle may be reached from the sea. U.S. survey parties will tackle the big topo mapping job for the area this summer.

Michigan highway program is really rolling along!

KEEP OUR ROADS ON THE GO

Michigan has already completed and put in operation 170 miles of the 1066 miles of roadway that is to be included in its Interstate Highway Program. A budget of 1¼ billion dollars has been allocated for highway construction and improvements from 1958 through 1962. In these five years, it is expected that 2900 miles of new highways of all classes will be laid, including 580 miles of expressways to be incorporated into the Interstate System, and 325 miles of other arterial highways of expressway design. At present, 180 miles of 4-lane highway is under contract and 500 million dollars worth of highway construction is in the survey and design stage. Michigan's extensive program is under the direction of John C. Mackie, State Highway Commissioner.

...and products of United States Steel

Michigan really rolls along!

34 miles of the Fenton-Clio bypass on Route 23 are practically completed. 28 miles of the Detroit-Toledo expressway (Rt. 24A) have been opened, and work is in progress on approaches into both cities.

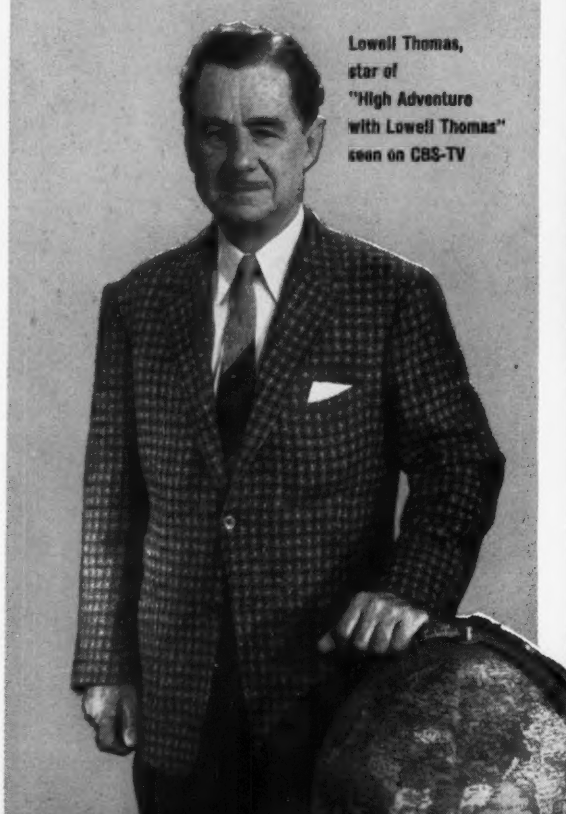
23 miles of relocated Route 16, west from Detroit, was opened to traffic last winter.

17 miles of Route 16, between Lansing and Portland, is open to traffic.

Excavation, grading and the construction of intersections have been started on a 6-mile section of Route 16 in the Portland area.

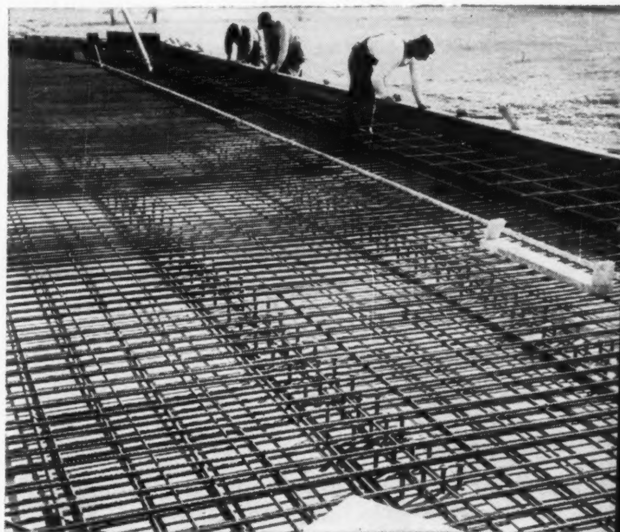
Although the world's longest suspension bridge over the Straits of Mackinac is not technically a part of the Interstate Highway Program, many miles of Routes 23 and 27 approaching this 96-million-dollar marvel will be controlled access expressways incorporated into the Interstate System. Perhaps not as obviously in the highways as in the bridge, steel helps to make both better, safer . . . even possible.

Lowell Thomas, CBS television and radio star, dramatizes the story of the building of the Mackinac Bridge in *"The Five Mile Dream."* This color motion picture is now being shown in major theatres all over the country. Be sure to see this exciting battle against time and nature when it plays in your local movie theatre.



Lowell Thomas, star of "High Adventure with Lowell Thomas" seen on CBS-TV

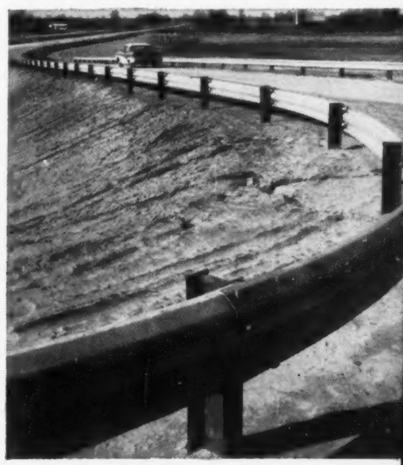
help keep these roads on the go!



It is expected that Michigan's Interstate System will utilize 725 tons of structural steel per million dollars of construction cost. Structural carbon and high strength steels have made the construction of overpasses, bridges and elevated expressways easier and less costly.

KEEP OUR ROADS ON THE GO

The concrete flooring and piers of a multitude of bridges in the Interstate Highway Program will be stronger and safer because of USS DI-LOK Reinforcing Bars which meet all requirements of ASTM Specifications A-15 and A-305.

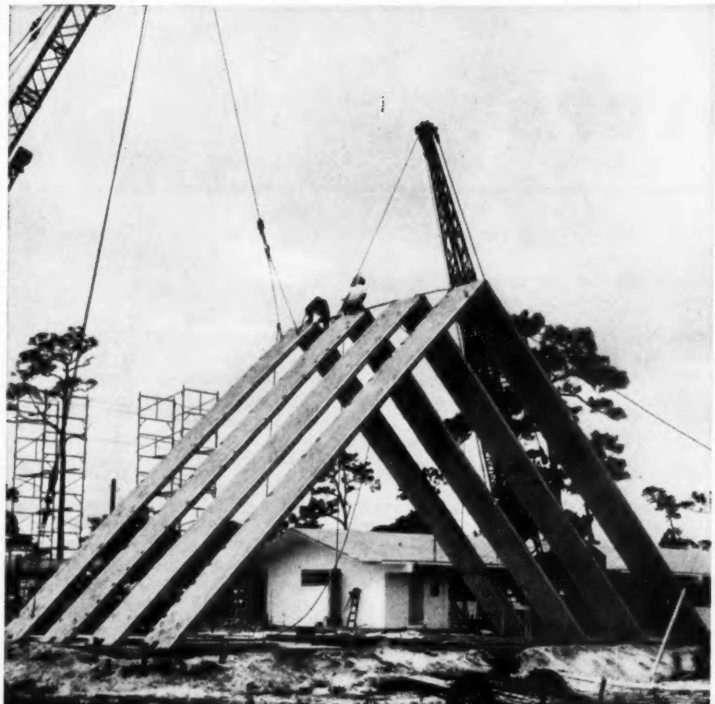


At Grand River, southwest of Portland on Route 16, steel helps to do difficult jobs quickly and economically. USS Steel Sheet Piling provides a safe working area in which to reach bedrock and begin construction of pier foundations. When fitted with USS TIGER BRAND Wire Rope, hoists, shovels and other earth-moving equipment have the strength and high resistance to abrasion and fatigue necessary for hard service.

On Route 16, between Lansing and Portland, welded wire fabric goes into place to reinforce the new concrete expressway. AMERICAN Welded Wire Fabric is made of high-grade, cold-drawn steel and is able to withstand high unit stresses. With it and UNIVERSAL ATLAS portland cements, it is possible to construct concrete slabs 50 to 100 feet long and provide a longer-lasting, smoother-riding roadway.

The interchange of Routes 23 and 57 is typical of the many interchanges which protect the traveler with steel guardrails. Building safety into the highways of the future is the prime concern of today's engineers. USS steel guardrails or galvanized highway guard cable at crucial points will help minimize the consequences of recklessness, and will safeguard traffic at the speeds the highway system has been designed for.

USS United States Steel



Working together, two cranes position prestressed slabs. 20 slabs are 5½" thick, 4' wide and 38½' long; 8 slabs are 4" x 4' x 38½'; there are 10 shorter slabs 4" x 4' x 30'.

• The St. Ambrose Episcopal Church in West Fort Lauderdale, Fla. is another example of the almost unlimited possibilities of modern precast, prestressed concrete construction.

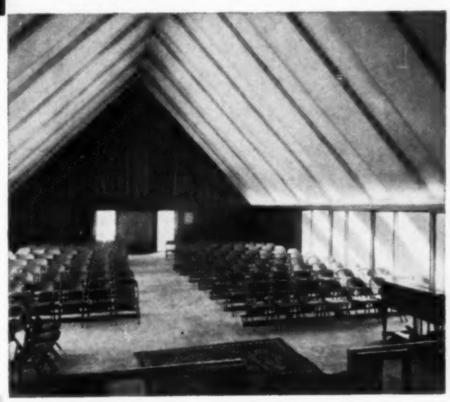
Just 38 prestressed slabs were required for this unique structure. Cast with plates imbedded at the ends and along the sides, slabs were fitted into slots in the footings, hoisted into place and welded together. The joints were coated with roofing material. That's all there was to it.

By eliminating conventional walls and roof, this technique resulted in substantial savings to the owner. The appearance of the completed job speaks for itself.

The prestressed slabs were made with Lehigh Early Strength Cement at the R. H. Wright & Son, Deerfield plant. Its use helps them save time and money in producing a variety of top quality concrete units.

NEW CHURCH DESIGN SHOWS VERSATILITY OF **PRECAST, PRESTRESSED CONCRETE**

On the interior, prestressed slabs were sprayed with an acoustical plaster.



Ample daylight flows into the church through the 5 open spaces on each side.

ARCHITECT: Johnson and McAlpine, Ft. Lauderdale, Fla.
CONTRACTOR: Quick Quality Construction, Inc., Ft. Lauderdale, Fla.
PRECAST, PRESTRESSED CONCRETE UNITS MANUFACTURED BY: R. H. Wright & Son, Ft. Lauderdale, Fla.

- LEHIGH EARLY STRENGTH CEMENT
- LEHIGH PORTLAND CEMENT
- LEHIGH AIR-ENTRAINING CEMENT
- LEHIGH MORTAR CEMENT

LEHIGH PORTLAND CEMENT COMPANY
Allentown, Pa.

NEWS BRIEFS . . .

First Power from St. Lawrence River

The $650,000,000 St. Lawrence Power Project, which the New York State Power Authority and its partner, Ontario Hydro, have been building since August 10, 1954, has reached its first completion stage, and soon will be generating hydroelectric power. Another fine example of international cooperation, construction of this big, complicated project is exactly on schedule—that is, first power is being delivered four years from ground breaking. On July 1, a 600-ft-long earth and rock cofferdam across the north channel of the St. Lawrence River, some distance upstream from the Barnhart Island Power Dam, will be breached to permit the river to flow through and fill the power pool behind the dam.

Within a few days after the explosion of 30 tons of dynamite has demolished the cofferdam, the power pool will have risen high enough to test the turbines and generators. Four generators have been installed to date by Ontario Hydro and four by the Power Authority. When all installations are completed in 1959, there will be 32 generators in operation.

The new lake, or power pool, will serve a twofold purpose. First, it will raise the level of the waters in the old International Rapids section of the St. Lawrence River, contain them within retaining dikes, and assure a constant, even flow to the turbine generators of the power plant, which operates at a head of 81 ft.

Second, the rising waters of the pool will provide a navigation channel around the power dam on the New York side in the vicinity of Massena by means of the Eisenhower and Snell Locks, and the Wiley-Dondero Canal. Ships of 14-ft draft will then shift from the old Canadian canal to the new waterway. Navigation will be limited to 14-ft draft until next spring, when dredging and other construction at various points along the Seaway are completed. In the spring of 1959 the Seaway will be able to accommodate ships of 27-ft draft.

On September 5, the power project is to be dedicated with appropriate international ceremonies. Generation of the entire potential is expected by September 1959, with Ontario Hydro and the Power Authority sharing equally the output of the 32 giant generators as they have shared the cost of construction. Each generator has a capacity of 57,000 kw; the capacity of the entire plant is 1,880,000 kw.

On the morning of July 1, demolition experts will complete the details of mining the cofferdam. The blast will open two 100-ft-wide gaps and loosen the balance of the cofferdam sufficiently to enable the rush of water to wash it away. Technical arrangements for the pool flooding will be in the hands of engineers from Ontario Hydro and the Power Authority, working under plans approved by the Joint Board of Engineers who are responsible for the coordination of power, navigation, and control of St. Lawrence and Great Lakes waters.

After navigation in the International Rapids section of the river has been stopped, the gates of Iroquois Dam, 25 miles upstream from the power dam, will be opened, permitting water to run into the power pool. Sufficient water will be allowed through Long Sault Dam to maintain navigation on the river between Cornwall and Montreal on the downstream side of the pool and to assure continued operation of existing hydroelectric power facilities.

The new lake will afford boating and other aquatic diversions, and Barnhart Island will become a state park, with a bathing beach and picnic facilities. New roads have been constructed, and municipal facilities, such as water and sewage disposal systems, have been installed for some St. Lawrence Valley communities.

For the Hydroelectric Power Commission of Ontario, Otto Holden, M. ASCE, is chief engineer; for the Power Authority of the State of New York, J. Burch McMorran, M. ASCE, is chief engineer. General contractor for the Canadian half of the power dam is Iroquois Contractors, Ltd., a combination of the Canadian Comstock Co., Ltd.; the Foundation Co. of Canada, Ltd.; Angus Robertson Ltd.; and Rayner and Armstrong, Ltd. The U.S. half of the power dam is being built by a joint venture consisting of B. Perini & Sons, Inc.; the Walsh Construction Co.; Peter Kiewit Sons Co.; Morrison-Knudsen Co., Inc.; and the Utah Construction Co.

[General articles on the billion-dollar St. Lawrence Seaway and Power Project are to be found in CIVIL ENGINEERING for November 1954, pages 33-39, and July 1957, pages 34-42.]

Mackinac Straits Bridge Is Dedicated

Across the Straits of Mackinac, where in 1634 explorer Jean Nicolet paddled his birchbark canoe expecting to find a passage to the Orient, stretches the recently completed five-mile-long Mackinac Bridge. On June 28 this beautiful $100,000,000 suspension bridge, with main span of 3,800 ft, was dedicated to public use. It was designed by D. B. Steinman, M. ASCE, for the Mackinac Bridge Authority. The foundations and piers were built by Merritt-Chapman & Scott, and the steel superstructure was fabricated and erected by the American Bridge Co. An article on design and construction of the structure was published in the May 1956 issue of "Civil Engineering" (page 37-50). The story of the whole bridge project is told in a recent book, "Miracle Bridge at Mackinac," by D. B. Steinman and John T. Nevill, published by the William B. Eerdmans Publishing Co., Grand Rapids, Mich.

U. S. Pavilion at Brussels Features Cable-Supported Roof

In structural concept the United States pavilion at the Brussels World's Fair, opened in May, is a modernistic circular structure of 380-ft dia, with a cable-supported roof of unique design having no interior columns to hold it up. As shown in Fig. 1, a double concentric row of exterior columns supports at its top a compression-ring truss at a height of about 70 ft above the ground. The tension ring in the center of the building is a drum-shaped truss, 66 ft in dia and 30 ft high, with its axis vertical.

Attached to the exterior compression ring are 36 2⅛-in.-dia cables, which extend radially to the bottom members of the central drum-truss and which constitute the principal support for the drum-truss. Also attached to the exterior compression ring are 72 1¼-in.-dia. cables, extending to the top of the central drum-truss. A system of diagonal rods connects the upper and lower cables to add rigidity to the roof. It is of interest to compare the structural concept of this pavilion with that of the Montevideo Stadium, described by M. Schupack, A.M. ASCE, in the April issue (page 53).

To the upper layer of cables were attached concentric rings of roof purlins, on which was laid a translucent polyester plastic roofing. The roofing was fabricated by the Kalwall Corporation of Manchester, N. H., from a plastic material called Hetron made by the Hooker Electrochemical Company, of Niagara Falls, N. Y.

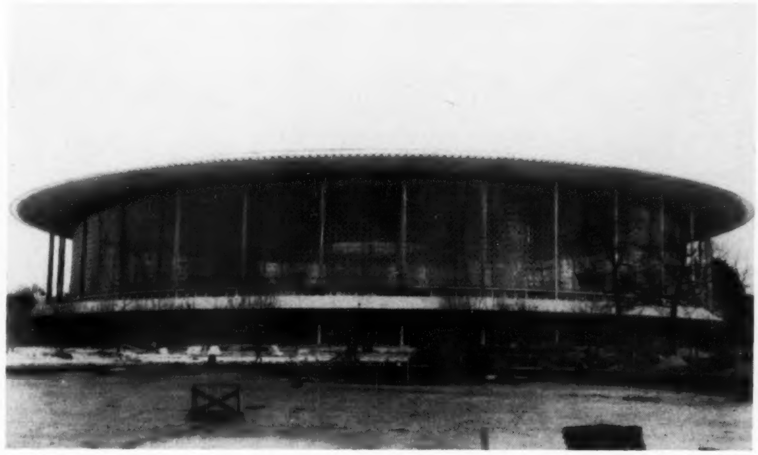
The exterior walls also are of plastic, in the form of transparent rigid vinyl panels located between the outer and inner rows of exterior columns, and running the entire 1,000-ft circumference of the American Exhibit Building.

Though the rigid vinyl used in the pavilion walls is designed as a temporary enclosure, it is reported that the engineers of the Bakelite Company (a division of Union Carbide) are perfecting it for permanent installation. The 27-by-56-in. panels, fabricated by Laminations, Inc., of Scranton, Pa., are .125 in. thick, and weigh less than 1 psf. The panels are bolted to a decorative steel lattice work.

Attached to the lower cables is an aluminum mesh ceiling, anodized in gold color, through which outside light filters to illuminate the interior. The central drum-truss is not roofed over.

Both concept and design are from the office of Edward D. Stone, New York architect. The steel work was fabricated by the German firm of Cologne-Wesselinger Eisenbau. The Belgian contracting firm of Blauton-Aubert built the pavilion.

The beautiful structure is featured on a recent U. S. commemorative postage stamp.



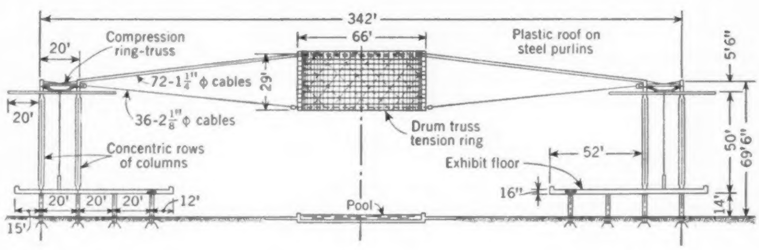


Fig. 1. U. S. pavilion at Brussels, shown here in cross section, is 380-ft-dia circular structure with cable-supported roof of unique design.

NSF Announces 246 Basic Research Grants

The National Science Foundation announces that 246 grants were made for the quarter ending March 31, 1958. The grants, totaling $4.7 million, were made for the support of basic research in the sciences, for conferences in support of science, for exchange of scientific information, for short-term research by medical students, and for the training of science teachers. Grants made during the first two quarters of the fiscal year totaled $20.5 million.

The research fields include astronomy, chemistry, biology, physics, the earth sciences, the engineering sciences, the mathematical sciences, and the social sciences. Grants were made to institutions and scientists in 38 states.

In the civil engineering field, the grants for the current quarter were made to the following institutions and principals:

1. California Institute of Technology: George W. Housner, A.M. ASCE, and Donald E. Hudson, for a study of Local Ground Motion of Strong-Motion Earthquakes, three years at $25,300.

2. Stanford University: Ray K. Linsley, Jr., M. ASCE, for a study of the Characteristics of Stream-Flow Hydrographs for Small Drainage Basins, two years, $20,000.

3. A four-day conference in the District of Columbia on the subject of Fractures, $7,000.

4. University of Illinois: Ralph B. Peck, M. ASCE, for a study of Illite and Illitic Soils, two years, $16,500.

5. Illinois Institute of Technology: Lloyd H. Donnell, for an investigation of the Large Shell Displacement Theory, two years, $8,400.

6. Illinois Institute of Technology: Philip G. Hodge, Jr., for an investigation of the Theory of Piecewise Linear Plasticity, two years, $23,000.

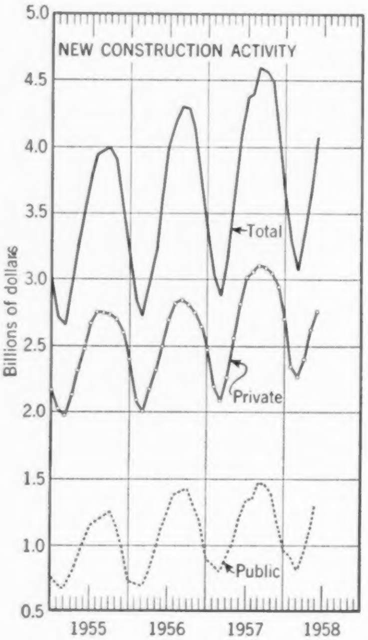
Dr. Alan T. Waterman is director of the National Science Foundation, with headquarters in Washington, D. C.

Construction Activity Rises Seasonally in May

New construction activity rose seasonally in May to $4.1 billion, according to preliminary joint estimates of the U. S. Departments of Commerce and Labor. The total dollar volume for the first five months of 1958, at $17.7 billion, was about the same as in the comparable period of 1957. The physical volume of work put in place is also estimated at about the same in both years.

The latest estimates reflect a 4 percent rise in public construction from the first five months of 1957, due primarily to increased spending for highways and public housing (mostly Capehart projects for the armed services). Private construction outlays thus far in 1958, at $12.5 billion, were slightly lower than a year ago.

The joint authorities note that the monthly estimates are determined primarily by past contract award movements, standard progress patterns, and assumed normal seasonal movements. They do not reflect the effects of varying numbers of working days in different months, nor of special conditions influencing the volume of activity in any given month, such as unusual weather, materials shortage, overtime, work stoppages, and postponements.



Seasonal rise in construction activity in May brings total for first five months of 1958 to $17.7 billion—about the same as in the comparable period of 1957.

New Rod Mill for Armco Steel Corp.

Construction work has started on the Sheffield Division-Armco Steel Corporation's new $14,000,000 rod mill at Kansas City, Mo. Designed to be one of the fastest 10-in. rod mills in the world, the new plant will have a speed of 6,000 fpm on rods and a production rate of 30 to 90 tons per hour for bar products. It will substantially increase the capacity of the company's Kansas City plant.

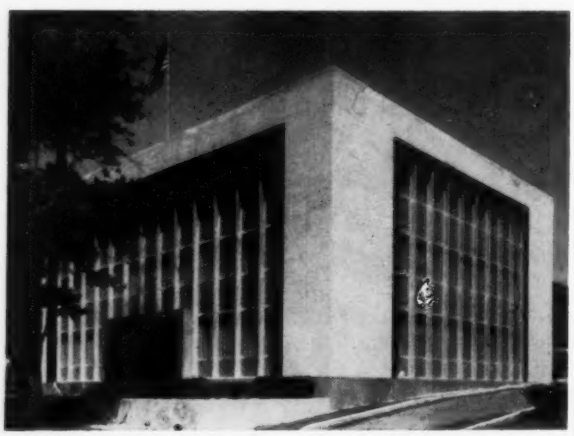
As general contractor for construction of the new mill, the Rust Engineering Company will coordinate the design and erect the mill building and install all mill machinery and auxiliary equipment.

Utility Company Changes Its Name

Shareowners of the American Gas and Electric Company have approved changing the company's name to the American Electric Power Company. American Gas and Electric is the parent company of six operating electric utilities serving more than 1,350,000 customers in parts of seven states. Philip Sporn, M. ASCE, is president of the 52-year-old company, which has its headquarters in New York City.

AGC Dedicates New Headquarters Building

Official opening of the Associated General Contractors' new headquarters building in Washington, D. C., took place on June 10. Vice President Richard Nixon was featured speaker and cut the ribbon across the main entrance. Mr. Nixon also sealed predictions of the physical facilities of the world of tomorrow in a time capsule in the building's cornerstone. The forecasts, which have been prepared by editors of several leading construction magazines, will be removed from the capsule at the turn of the century and compared with the realities.



New AGC headquarters building provides the association with 19,000 sq ft of office space. It has been under construction since March 1957 and was officially dedicated on June 10. The cost was about $762,000.

AGC President Fred W. Heldenfels, of Corpus Christi, Tex., spoke on behalf of the dedication, and Past-President Frank J. Rooney, chairman of the Building Committee, acted as master of ceremonies. Also taking part in the program was AIA President Leon Chatelain, Jr., whose firm, Chatelain, Gauger and Nolan, designed the building. The general contractor was the Joseph F. Nebel Co. Both are Washington firms.

Located at 20th and F Streets, the three-story building is faced with buff limestone and trimmed with black granite. The large glass windows are tinted and have dull aluminum mullions. Porcelainized steel spandrels are aqua colored to match the glass. The lobby features rose crystal marble walls and terrazzo floor with the AGC emblem inlaid in ceramic tile. The walnut-panelled board room, running the length of the third floor, can be broken up into conference rooms by means of folding doors. The cost of the building and land was about $762,000.

Modern Freeway Planned For Des Moines, Iowa

A $55,000,000 ultra-modern freeway will carry traffic through Des Moines, Iowa, connecting with the Iowa Interstate system northeast of the city and west of West Des Moines. Since the new route will be part of the projected 41,000-mile national network, the federal government will pay 90 percent of the cost and the state 10 percent. Construction will be handled by the Iowa State Highway Commission.

From four to eight lanes wide, the 13.5-mile concrete highway was designed to meet traffic needs twenty years from now as well as current demands. There will be a 36-ft-wide divider strip. The freeway will be depressed in some areas and elevated in others, avoiding grade crossings and the need for traffic lights. Twenty-one interchanges will provide for entering and leaving the route. Some 500 acres will be required for the freeway and interchanges, and more than 1,100 homes must be demolished to make way for the project.

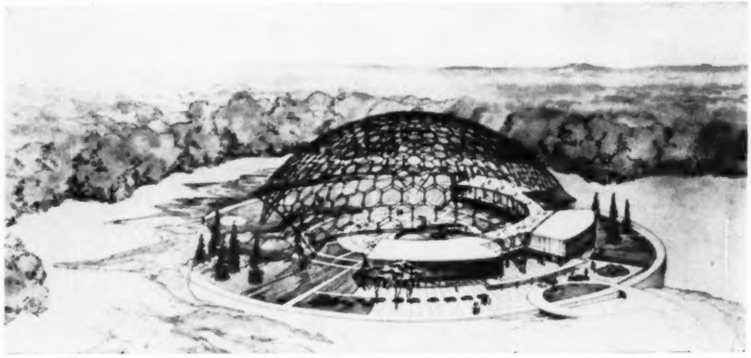
The freeway route was recommended by the Kansas City engineering firm of Howard, Needles, Tammen and Bergendoff, which did the planning. On the day the freeway route was announced the *Des Moines Tribune* issued a special eight-page supplement, explaining why the recommended route was chosen over the others considered and covering the planning, designing, and financing. The engineers hailed its "outstanding job in giving the facts about the freeway" and called the coverage a model "of how such a story should be covered."

Final Work on AASHO Test Site

A new, and final, construction season has begun on the AASHO road test site at Ottawa, Ill. The final phases of construction are under a $5,960,000 contract awarded last year to the S. J. Groves and Sons Company, of Minneapolis, Minn. The $22,000,000 test facility—six loops containing 836 separate test sections—will be completed and ready for traffic in the late summer. The test sections will have nearly 200 different combinations of surfacing and underlying layers of material. The project is on the right-of-way for a future east-west highway in the Interstate System. When the two-year test has been completed, the test pavements will revert to the State of Illinois.

The project is sponsored by the American Association of State Highway Officials and administered by the Highway Research Board. Its cost is being shared by the states, the Bureau of Public Roads, the Automobile Manufacturers Association, and the American Petroleum Institute. The Department of Defense will furnish Army troops to drive the test vehicles.

Geodesic Space Lattice Dome for ASM Headquarters



New $2,000,000 headquarters building of the American Society for Metals will feature a giant geodesic space lattice dome. A contract for building the dome has just been awarded to the Columbus Division of North American Aviation, Inc. The structure, which will be 250 ft in dia and 103 ft high, will consist of 11-ft aluminum hexagonal sections having a honeycomb appearance. Weighing approximately 200,000 lb, the space lattice will be supported by five pylons. Two of the pylons descend inside the dome and into the court, providing support for the headquarters building. The building itself will be on three levels in a 168-deg semicircle. Located 35 miles east of Cleveland, Ohio, the project will demonstrate the versatility of metal as a building material.

Radar-Photogrammetic Methods Speed Road Surveys

H. A. Radzikowski and S. E. Ridge, chief and assistant chief in the Division of Development, Office of Operations of the Bureau of Public Roads, have reported new developments in the integration of photogrammetry and electronic computers into the terrain analysis process for the location of highways and the geometric stake-out on the construction site. These steps are:

1. Airborne radar scanning and recording of terrain profile for use in establishing map scale and in bridging ground control from known ground monuments.
2. Automatic orientation of aerial photographic pairs in a stereoplotter to form an accurate three-dimension image of the terrain where a highway may be located.
3. Automatic measurement and recording of the elevation of the original ground along the line where the highway may be located from these dimensional photograph images.

The instruments were developed by G. L. Hobrough, of the Photographic Survey Corporation, Ltd., of Toronto. The corporation is affiliated with Hunting Associates, Ltd. Another affiliate, Photronix, Inc., of Columbus, Ohio, under the direction of Everett S. Preston, chief engineer, is developing methods for the integration of the new instrumentation into the highway work flow processes.

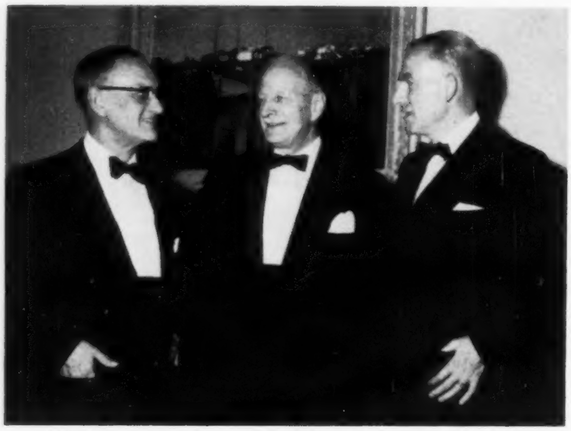
A newly developed automatic scanning correlator, called "AUSCOR," automatically adjusts the photographs in the stereoplotters in a matter of minutes. As the sensing head is moved about horizontally by the operator, AUSCOR raises or lowers it with changing elevations and transmits this vertical movement to the metering device. A scanning speed of 4 in. per sec along a profile has been demonstrated, and refinements are being incorporated to increase this by a factor in excess of five.

AUSCOR is considered a major breakthrough for the eventual automatic production of contour maps where needed. In producing contour maps, the sensing device that now automatically controls the vertical movement to obtain elevations will, when the additional controls are developed, automatically control the horizontal movement of the plotter head along lines of equal elevation.

The next step will be to couple the metering device on AUSCOR to magnetic tapes for automatic recording and storing of the three dimensions of the scanned terrain. This will reduce the need for contour maps for final highway location purposes by automatically analyzing on an electronic computer the location of a highway on the terrain model stored on the magnetic tape.

It is estimated that AUSCOR will, even in its present state of development, increase the speed of obtaining terrain information by photogrammetry for highway engineering use by a factor of four. Additional development now contemplated should substantially increase this estimate.

Canadian Projects Featured at EIC Annual Meeting



C. M. Anson (left), retiring president of the EIC, was host at a dinner to honor officers and past officers of the Institute. Shown with him are L. Austin Wright (center), M. ASCE, retiring general secretary, and K. F. Tupper, new EIC president.

A wide range of Canadian engineering projects was discussed during the Engineering Institute of Canada's 72nd annual meeting, held in Quebec, May 21-23. The 37 papers presented covered such current projects as the Deas Island Tunnel; the remodeling and raising of the Jacques Cartier Bridge, necessitated by the St. Lawrence Seaway Project; the new highway connecting Quebec and Seven Islands; the Chute des Passes underground hydroelectric plant being built in Quebec and similar Canadian installations already in operation; and the Beechwood power development with its unique salmon hoist. A paper on the Canadian program for the International Geophysical year revealed that Canada has 80 stations taking measurements, including a number in Arctic areas.

Regular publication of the EIC Transactions to supplement the Institute's *Engineering Journal* was announced. To be published four times a year, the Transactions will contain papers of special engineering or scientific importance.

Honorary medals were presented to R. E. Heartz, M. ASCE, president of the Shawinigan Engineering Co. of Montreal, and R. E. Jamieson, dean emeritus of engineering at McGill University. New elections to honorary membership included L. Austin Wright, M. ASCE, who is retiring as general secretary of the Institute after twenty years in the post. Dr. Wright was the recipient of many tributes and gifts presented at a large luncheon in his honor held at the Chateau Frontenac.

Dr. Wright's successor as general secretary is Dr. Garnet T. Page, former secretary of the Chemical Institute of Canada. At the close of the meeting, K. F. Tupper, of Toronto, was installed as president for the coming year.

New Brooklyn Pier Ready for Shipping

Dedication of Pier 11, the first of ten to be completed under the Port of New York Authority's $85,000,000 seven-year redevelopment program, took place this June. Located in the Atlantic Basin area of the Brooklyn-Port Authority Piers, the new $8,250,000 project has three "king-size" berths and a shed 1,800 ft long by 150 ft wide. Some 1,500 dignitaries and guests saw the 2,100-ft-long quay-type pier dedicated. A terminal for the Maersk Line, the pier will handle an estimated 400,000 tons of cargo annually and earn about $2,000,000.

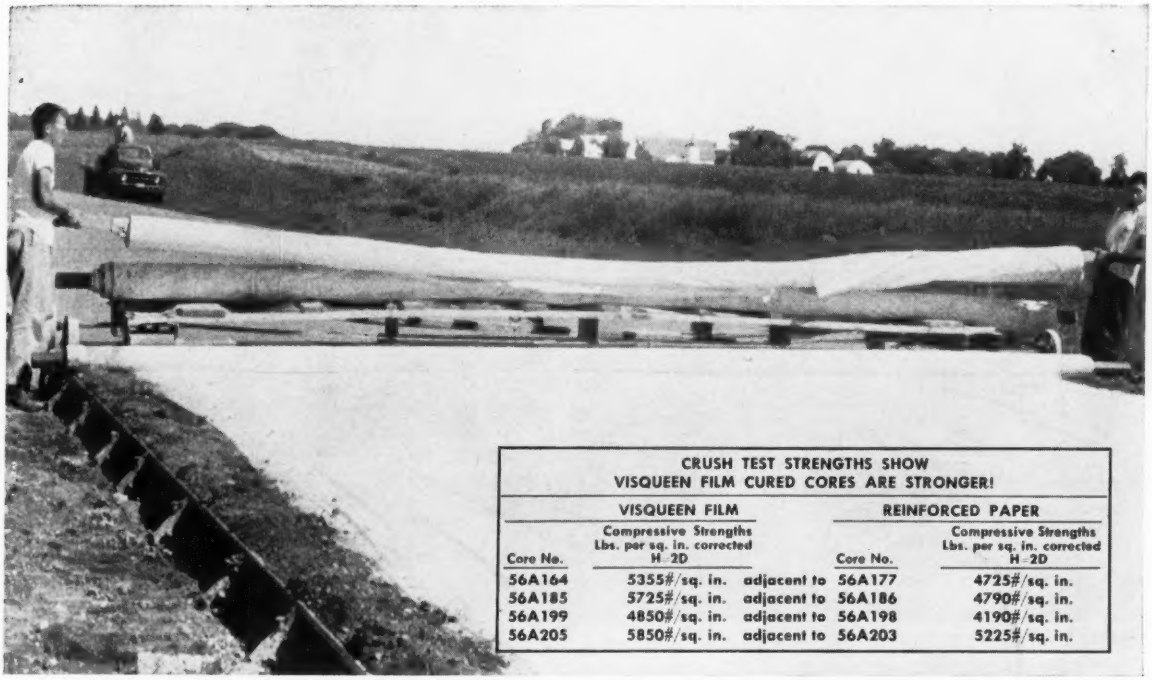
Army Awards Large Contract for Tractors

The Caterpillar Tractor Company has been awarded a $11,722,980 low-bid contract to furnish D8 Tractors to the Army Corps of Engineers for distribution to Army units around the world. According to E. B. English, government sales manager, the contract represents the company's largest single peacetime order. The units will be shipped from the company's Peoria plant in August, September, and October for use in the construction of airports and roads, port rehabilitation, and other heavy-duty work. The D8 is the second largest model of crawler tractor built by Caterpillar.

New Potomac River Bridge

A bill authorizing immediate construction of a new Potomac River bridge has been passed by the Senate and sent to the White House. The bridge, linking the District of Columbia and Virginia, will cross Theodore Roosevelt Island about a quarter-mile upstream from Memorial Bridge. It will be the fifth bridge over the main Potomac channel. The others are the Fourteenth Street, Memorial, Key, and Chain Bridges.

3 Minutes With These Facts Can Put Money In Your Pocket!



CRUSH TEST STRENGTHS SHOW VISQUEEN FILM CURED CORES ARE STRONGER!

VISQUEEN FILM			REINFORCED PAPER	
Core No.	Compressive Strengths Lbs. per sq. in. corrected H=2D		Core No.	Compressive Strengths Lbs. per sq. in. corrected H=2D
56A164	5355#/sq. in.	adjacent to	56A177	4725#/sq. in.
56A185	5725#/sq. in.	adjacent to	56A186	4790#/sq. in.
56A199	4850#/sq. in.	adjacent to	56A198	4190#/sq. in.
56A205	5850#/sq. in.	adjacent to	56A203	5225#/sq. in.

ONLY WHITE OPAQUE VISQUEEN FILM GIVES YOU THESE COST-CUTTING ADVANTAGES FOR CONCRETE CURING

TRADE MARK

ADVANTAGE	REASON WHY
1. Up to 23 re-uses plus low first cost cut curing costs to a fraction of a cent /sq. ft. of .004″ white opaque VISQUEEN film.	1. Superior uniformity of thickness. No thin, weak spots. A *stronger* curing blanket—hence greater durability.
2. Lower Labor Costs.	2. Far lighter than other materials. Hence easier, more speedily handled. 1,000 sq. ft. weighs only 20 lbs. *Stays* light—will not absorb moisture.
3. Saves Time and Handling.	3. Additional watering not needed. Film rolls up easily. Needs no drying or special handling.
4. Safe and Stable.	4. Inert. No chemical reactions with concrete. Leaves no deposit. Will not rot or mildew.
5. Wider Widths, Better Packaging.	5. Only VISQUEEN film comes in standard widths—or blankets—and *seamless* widths through 32′. Available in 14′ roll widths with no folds.
6. Additional Uses.	6. VISQUEEN film is used by road builders and contractors for rain blankets, equipment and material covers.
7. Stronger Cures.	7. See chart in illustration.

Write For Complete Information Or Use The Information Request Tag Below.

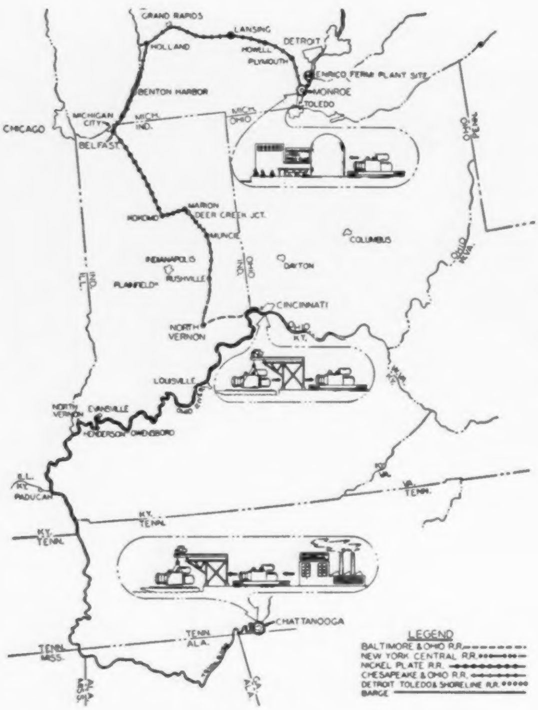
Information request tag
VisQueen
Trade Mark
clip this tag— #CV7
attach to letterhead, mail.

VISQUEEN *film—first and foremost polyethylene film. A product of the long experience and outstanding research of* **VISKING COMPANY** *Division of* UNION CARBIDE *Corporation*
P. O. Box 1410, Terre Haute, Indiana

In Canada: VISKING COMPANY DIVISION OF UNION CARBIDE CANADA LIMITED, Lindsay, Ontario.

VISKING, VISQUEEN and UNION CARBIDE are registered trademarks of Union Carbide Corporation.

Shipping Reactor Vessel—Mighty Moving Problem

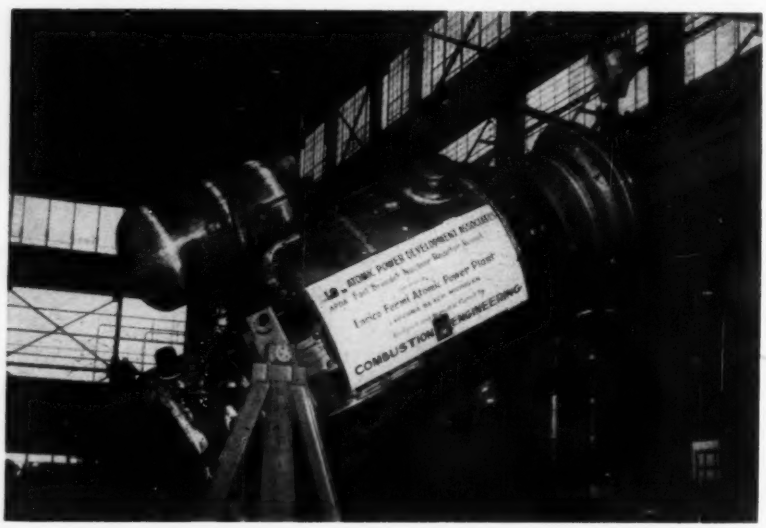


Complicated 1,598-mile route taken in moving reactor vessel from Chattanooga, Tenn., to Lagoona Beach, Mich., is traced on this map. Five railroads cooperated in the 670-mile land phase of the trip.

Transporting this 91-ton steel container—heart of the world's largest breeder reactor atomic plant—from Chattanooga, Tenn., where it was built, to the Enrico Fermi Atomic Plant on Lake Erie, 30 miles south of Detroit—was one of the most difficult moving jobs in industrial history. Planning for the 1,598-mile journey by barge and rail began in September 1955, immediately after the order for the vessel was placed with the Combustion Engineering Company.

The trip, starting by barge on April 10, carried the cumbersome cargo over 928 miles of the Tennessee and Ohio Rivers. Five railroads cooperated in the final 670-mile rail leg of the journey from Columbia Park, Ohio, to Lagoona Beach, Mich. Average rail speed was only 10 to 15 mph. Clearance problems were acute, involving a careful check of bridges, trestles, underpasses, tree limbs, wires, and telephone cables. At Delaware, Ind., a highway bridge over the Baltimore and Ohio tracks was raised and widened. To guard against unforeseeable problems or damage, a pilot car preceded the flat car carrying the container.

At Lagoona Beach a crane lifted the unit from the flat car and into position in the 72-ft-high gas-tight reactor containment building at the Enrico Fermi Plant Site. It is the production of plutonium that stamps the Enrico reactor as the breeder type. A liquid-sodium cooled plant, the Fermi reactor will be the only privately financed reactor in the world with the unique ability to make more fuel than it uses while, at the same time, producing energy for steam-electric power generation.



Over a month and concerted effort were required to transport this huge 91-ton steel container from Chattanooga, Tenn., where it was manufactured, to Lagoona Beach, Mich., where it was installed in the Enrico Fermi Atomic Power Plant. The vessel was built from basic designs specified by Atomic Power Development Associates, Inc., the 43-company non-profit organization responsible for research, development and design for the Fermi project.

Ceco Steel to Erect Mill at Lemont, Ill.

Plans for erecting an $11,000,000 bar steel mill at Lemont, Ill., are announced by the Ceco Steel Products Corporation. The Chicago fabricating company, one of the nation's top suppliers of structural and related steel products for the construction industry, will produce steel solely for its own use in the new plant. It will operate the plant under the name of the Lemont Manufacturing Corporation, a new wholly-owned subsidiary. Capacity of the mill will be 120,000 tons of billet-sized ingots a year.

The mill is expected to be in operation by the fall of 1959 and running at full capacity by 1960. It will produce a wide range of products, including small structural shapes such as channels and angles, rounds from ⅜ to 2¼ in. in dia, all sizes of reinforcing bars for concrete, and special sections used in architectural building applications.

Mammoth Pool Contract Let

The S. Morgan Smith Company, of York, Pa., has been awarded a contract for two Francis-type hydraulic turbine units with inlet valves and pressure regulators for the Mammoth Pool hydroelectric project of the Southern California Edison Company. These units are of the vertical-shaft type, with shop-welded plate steel spiral cases. They will be the highest head reaction-type turbines in the United States. Each unit is rated at 88,000 hp at a speed of 360 rpm under an average net head of 950 ft. The turbine and valve equipment will be shipped during the spring and summer of 1959.

The site of the Mammoth Pool powerhouse is on the upper San Joaquin River about 65 miles northeast of Fresno, at an elevation of 2,230 ft above sea level. The dam and intake equipment are in the Sierra-Nevada Mountains, over 1,000 ft higher. Because of its proximity to other units of the Big Creek-San Joaquin River project, the completed plant will be operated by remote control, with closed-circuit television monitoring of instrumentation.

Consulting engineers to the Edison Company on the project are the Bechtel Corporation, of San Francisco.

N*G*Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"You didn't fool me," bragged Joe Kerr.

"On the \$400,000,000 program of the Calizona Highway Department for 1959?"

"That's what I mean, Professor. Look at this chart:

Million	U	C	E	T
50	1	1	39	37
100	2	3	40	60
200	4	7	45	95
400	8	*15*	*67*	*121*

"You gave us the first 3 lines of data, that is, 39 engineers assisted by 37 technicians and one computer handled one \$50,000,000 unit in 1956, etc. There is a linear relation between units and computers, $c=2u-1$, so for the 8 units in 1959, I computed 15 computers. The other relations are parabolic:

$$e = 39 + \tfrac{1}{2}u(u-1)$$
$$t = 37 + \tfrac{1}{6}(u-1)(160-11u)$$

giving for $u=8$, $e=67$ and $t=121$. You asked how few new men must be recruited and wanted me to say 22 engineers and 26 technicians, or 48 men, but I wont. You didn't fool me!"

"Then what is your answer?"

"I have NONE. First, there isn't any Calizona: California cant annex Arizona and Arizona wont annex California. Second, the equations show that it would take 39 engineers and 10.3 technicians assisted by -1 computer to do nothing at all, and they would all be fired. Third . . ."

"Third, Joe didn't know how," finished Cal Klater. "Even tho they work together as a team, it is sensible to express the capabilities of men and machines in terms of their shares of the annual output. Using the respective capitals:

$$C + 39E + 37T = 50$$
$$3C + 40E + 60T = 100$$
$$7C + 45E + 95T = 200$$

Whence $C = 23$, $E = 0.55$, and $T = 0.15$, in \$million per yr. In 1959, the present set-up plus 8 more computers will handle \$384 million. So for the balance,

$$.55e + .15t = 16$$

which is a diophantine with the solution

$$e = 1 + 3n;\ 1 = 103 - 11n$$

There are 10 sets of positive solutions, but for minimum recruitment, $n = 9$, $e = 28$; $t = 4$ and $e + t = 32$ recruited."

"Now let me finish," demanded Joe. "Why not $n = 10$, recruiting 31 engineers and firing 7 technicians. Or better yet, $n = 13$, $e = 40$, $t = 40$, so that if you pick the 40 aptest technicians and make them engineers by intensive training, you would recruit the NONE I gave as my answer!"

"Nice try," laughed the Professor, "but you wouldn't get more than a couple out of 95. My answer was 31, but I'm accepting Cal's 32, too.

"Now let's help our bewildered Committee on Boroughs and Wards. For 19 aldermen, they must divide a population of 41,078 into 15 wards—the big first and eleventh represented by 3 aldermen apiece and each of the other 13 by one. Then for 4 judges, they must group the wards into 4 boroughs, one of 4 wards and 3 with 5 apiece. Obviously this cant be done with perfect equity and wont be done without the usual gerrymandering of odd-size precincts, but as a first approach, how many should be in each ward and in each borough so that the departure of these respective numbers from proportionality is minimized by the rule of least squares?"

[Klaters and Kerrs were Ab Stract (Manuel A. Benson), Ed C. Holt Jr., Dennis Vickers, Thatchrite (Guy C. Thatcher), Sauer Doe (Marvin Larson), and Jack Geiger. Also acknowledged are solutions to the Voluntary Fund problem from James M. Gere, Don Milks, Henry W. Troelsch, B. R. Ingalls, C. W. Trigg, and Leslie W. Stocker. Any resemblance between the new problem and the Society's districts and zones is neither untimely, unintentional, nor uncoincidental.]

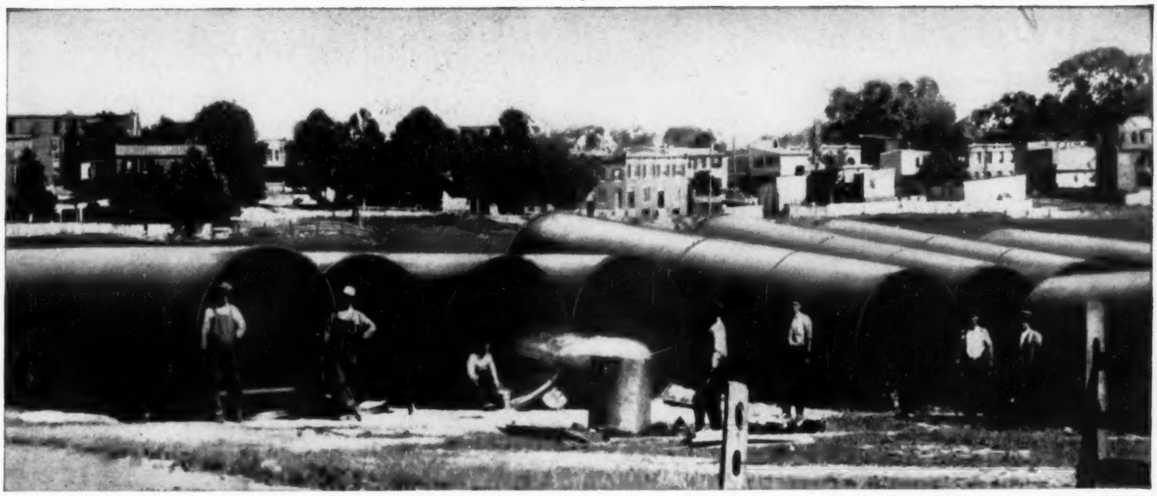
Engineers Qualify for Fellowship Program

This July the Organization of American States will begin a fellowship program with the dual purpose of helping individual engineers and scientists as well as the OAS member states. The new program, which has been recommended by the Inter-American Committee of Presidential Representatives, will offer grants for advanced study or research to specialists throughout the Western Hemisphere. By making possible advanced study abroad, the OAS hopes to increase the individual's contribution to his own country. Grants will cover travel, registration and tuition fees, study or work materials, and room and board. There will be about 170 of these fellowships available in the 1958-1959 school year and some 500 annually thereafter.

Qualified persons who are looking for an opportunity to do pure research, improve their professional skill through postgraduate work, or enroll for advanced technical study may write now for the necessary forms. Inquiries should be sent to the Technical Secretary, OAS Fellowship Program, Pan American Union, Washington 6, D. C.

U.S. Steel to Have Aluminum Coating Plant

Plans to enter the aluminum coated steel sheet market late in 1959 are revealed by the United States Steel Corporation. In making the announcement, Executive Vice President Richard F. Sertner said the company's galvanizing line at the Irwin works, near Dravosburg, Pa., will be altered to include the production of aluminum coated steel sheets.



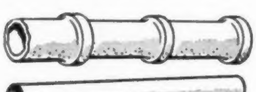
Applying coal-tar enamel in 1915.

Steel Pipe in good shape after 42 years

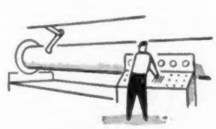
Way back in 1915, Baltimore's Board of Water Supply installed an 84-in. steel main to distribute water from the Montebello Filtration Plant. The 4057-ft-long line is made up of riveted $\frac{7}{16}$-in.-thick plates, and was hand-daubed with old style Bitumastic coal-tar enamel.

Today, after 42 years of almost constant use, this line is still giving fine service, with no apparent loss of flow capacity. The last internal inspection of the line, in 1939, indicated the pipe and its coating to be in excellent condition.

Baltimore is but one of many cities that has had long and successful experience with steel pipe. And, since today's steel pipe is vastly improved—better fabricating methods, better joints, better protective materials—we can safely conclude that *there is no known limit to the service life of coal-tar enameled steel water pipe.*



COMPARE THE COSTS—This drawing compares a single 40-ft length of steel pipe with 16-ft lengths of rigid-walled pipe of the same inside diameter. The steel pipe has thinner walls and a smaller outside diameter; weighs only about one-fifth as much per ft of length. Results: the steel pipe costs less to ship, to handle, and to lay. It requires a smaller ditch, fewer bell holes, fewer joints—only 132 per mile.

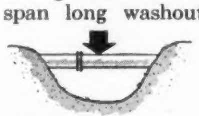


TESTED FOR STRENGTH—Every length of steel pipe is hydrostatically tested at the shop in accordance with AWWA specifications—usually to double the working pressure. What's more, steel pipe can withstand from 3 to 4 times the working pressure before bursting. And steel pipe safely resists water-hammer, shock loadings, and surge.

LEAKPROOF JOINTS—100 pct bottle-tight joints are a practical reality with steel pipe, whether Dresser couplings or welds are used. That means no water wastage, no costly washouts. And you needn't fear contamination of the contents due to infiltration from without. These joints are quickly made, they're permanent, and they're strong.

CORROSION-RESISTANCE—Modern methods of lining steel pipe with hot-spun coal-tar enamel make it immune to corrosion and incrustation. There is no known time limit to this protection. Many tar-enameled lines have been in service for upwards of fifty years. Coal-tar enamel provides the smoothest surface obtainable, assuring high flow coefficients year after year. Coatings and wrappings protect the pipe from moisture, acids, and alkalis.

BEAM STRENGTH—Steel pipe has the structural strength that is characteristic of tubular steel. It can span long washouts; is often handled in multiple lengths during installation. And steel pipe can stand up under the weight of heavy cover.



WIDELY USED—Some recent users of Bethlehem Steel Pipe are New York City, New Orleans, Philadelphia, Savannah, Reading, Cincinnati, Atlanta, Omaha, Worcester, Colorado Springs, and Boston. Further proof of the superior qualities of steel pipe is its use in thousands of miles of large-diameter gas and oil lines, as well as in high-pressure penstocks throughout the world.

For further information about steel water pipe, kindly contact the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

DECEASED

Warren D. Brockway (A.M. '45), age 54, project engineer for the Federal Public Housing Administration in Miami Beach, Fla., died in Miami on May 17. Mr. Brockway had spent almost all his professional life in Florida, having served as inspector for the Okeechobee Flood Control District, superintendent of Richlands, Inc., and party chief with the U. S. Sugar Corporation. In the early nineteen-forties, he joined the Housing Administration as site improvement inspector.

Carey R. Browning (M. '44), age 79, consulting engineer and water expert of Tustin, Calif., died there on May 2. Upon graduation from the University of California in 1904, Mr. Browning worked as a mining engineer. Joining the Irvine Company in 1910, he was with it for more than 30 years. In 1944, Mr. Browning acquired a partnership interest in the Tustin Cement Pipe Company. Known throughout the state as a water engineering authority, he served on the board of the Orange County Water District for many years.

William D. Clarke (M. '23), age 78, retired residential appraiser for the War Assets Administration in Tacoma, and Seattle, Wash., died in Portland, Ore., on April 28. Mr. Clarke studied at Pacific University and Amherst College and received his engineering degree from the Massachusetts Institute of Technology. He was engaged in railroad location and construction in Washington, California, and Oregon, and served as division engineer for the Oregon State Highway Department for 14 years. For ten years he was in the National Park Service, Western Region. A veteran of World War I with the Corps of Engineers, Mr. Clarke was industrial analyst for the Tacoma branch office of the War Production Board during World War II.

James H. Dugan (M. '37), age 72, pioneering expert in tunnel design, died in Mechanicville, N. Y., on May 11. Mr. Dugan, who was graduated from Rensselaer Polytechnic Institute, began his career as a civil engineer with the Board of Transportation in New York City. He was a member of the staff that designed the Holland Tunnel and he later served as assistant chief designing engineer on the Lincoln Tunnel. Later he was chief designing engineer for the Queens Midtown Tunnel and the Battery tunnels. He was instrumental in solving the serious ventilation and soft ground excavation problems that faced the builders of the tunnels.

Wilbur S. Hanna (M. '20), age 78, retired pioneer irrigation consultant with the U. S. Indian Service, died in Billings, Mont., on April 10. Mr. Hanna was a veteran of the Spanish-American War when he entered Purdue University. Soon after graduation, he joined the Bureau of Indian Affairs with which he worked closely for 45 years. For many years Mr. Hanna was supervising engineer for all Indian irrigation projects between the Great Lakes and the Pacific Ocean.

Walter L. Hempelmann (M. '15), age 75, retired consulting engineer of Evanston, Ill., died there on April 30. A graduate of Washington University in St. Louis, Mo., Mr. Hempelmann had served as consulting engineer for the Chicago Division of the Texas Company for 32 years. He had been retired since 1947.

William R. Hillyer (M. '03), age 91, retired civil engineer of New Concord, Ohio, died there on April 24. Mr. Hillyer studied at the Stevens Institute of Technology. He had served as assistant commissioner of public works for Richmond Borough in New York City and deputy commissioner of water, gas, and electricity, also in New York. In 1927, Mr. Hillyer became village engineer of New Concord, a position he held for many years.

Frederick P. Kafka (M. '12), age 83, retired civil engineer, died in Pelham, N. Y., on May 14. Mr. Kafka was a graduate of New York University and a veteran of the Spanish-American War. He had engaged in private practice as a designing and consulting structural engineer in the New York metropolitan area. For almost 20 years he was president and general manager of the Fireproof Products Company and the Fireproof Contractors Corporation of New York. From 1935 until his retirement, Mr. Kafka held the posts of construction engineer with the U. S. Treasury Department and the Public Buildings Administration. In these positions he was in charge of the construction of a number of important government buildings.

Max C. Koehler (A.M. '44), age 57, civil engineer with the Corps of Engineers in Seattle, Wash., died there on May 19. Mr. Koehler had served as conduit engineer and general foreman of conduit construction with the Portland (Ore.) Electric Power Company. Before joining the Corps of Engineers he was with the U. S. Bureau of Public Roads. He had served as chief draftsman and associate engineer in the U. S. Engineer Office in Seattle. He was educated at Stanford University.

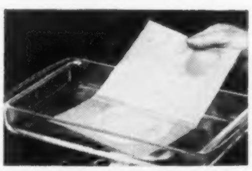
David Lowensohn (M. '14), age 78, president of the Lowensohn Construction Company, Inc., and a prominent Cleveland builder, died in Cleveland, Ohio, on March 8. Mr. Lowensohn received his civil engineering degree from Ohio State University. He served as the only United States engineer on the construction of the Cerro de Pasco railway in the Andes Mountains in Peru. His company's many projects included the Lorain-Carnegie Bridge and the Lorain Road Bridge

(Continued on page 108)

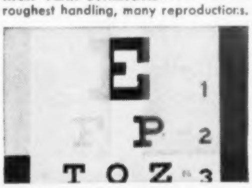
NOW AVAILABLE!

New drafting films made with Du Pont Mylar® resist rough handling . . . safeguard your investment

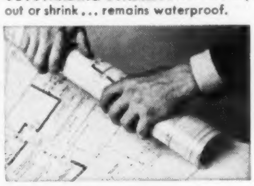
HIGH TEAR STRENGTH . . . withstands roughest handling, many reproductions.



OUTSTANDING STABILITY . . . won't dry out or shrink . . . remains waterproof.



SUPERIOR TRANSLUCENCY . . . faster, more accurate printing . . . fiber-free.



GREATER FLEXIBILITY . . . rolls up repeatedly without cracking . . . lies flat.

SEND FOR FREE SAMPLES. See for yourself the many performance advantages you get with new drafting films made with "Mylar" polyester film. Send for your sample sheets today! Write E. I. du Pont de Nemours & Co. (Inc.), Film Dept., Room CE-7, Wilmington 98, Delaware.

Now you can safeguard your investment in costly original drawings by using the new pencil and ink drafting films made with Du Pont "Mylar"* polyester film. What's more, these crack-resistant drafting films *cost no more* than many grades of cloth!

Look at the remarkable combination of benefits found in these new drafting films! They resist tearing . . . won't embrittle with heat used in reproduction . . . won't yellow with age . . . won't soak up moisture or grease from hands . . . remain waterproof. Next time you order, specify drafting film made with Du Pont "Mylar".

*"Mylar" is a registered trademark for Du Pont's brand of polyester film. Du Pont makes the base material "Mylar"—most leading manufacturers of drafting materials are now offering pencil and ink drafting films made with Du Pont "Mylar".

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT
MYLAR®
POLYESTER FILM

Deceased

(Continued from page 106)

over the Rocky River Valley. In addition to heading his own construction company, Mr. Lowensohn was president of the Bedford Distilling Company, the National Engineering and Contracting Company, the Euclid Shale Brick Company, and the Sir Edward Company, a New York import firm.

Claude P. Marsh (M. '23), age 78, retired assistant engineer with the New York Central Railroad, died recently in New York City. A graduate of Rensselaer Polytechnic Institute, Mr. Marsh had been an instructor in civil engineering at the University of Pennsylvania, and instructor and assistant professor of civil engineering at the University of Cincinnati. For several years, he was engineer of structures with the Cleveland Union Terminals Company in Cleveland, Ohio. He returned to New York where he served the New York Central for many years.

Sam L. McGlathery (A.M. '11), age 72, who retired in 1947 from the legal department of the U. S. Corps of Engineers in Galveston, Tex., died there recently. Mr. McGlathery, a graduate of Louisiana State University, served as chief of engineering design and bridge division and as district engineer in the Philippines with the Corps of Engineers. During World War I, he was a captain in the Corps in France. Before his transfer to Galveston in 1943 Mr. McGlathery was area engineer in the New Orleans District.

Theodore H. McKibben (M. '28), age 73, retired railroad engineer and executive with the Atchison, Topeka, and Santa Fe Railway Company, died in Chicago, Ill., on June 2. Mr. McKibben was assistant chief engineer of the road's Eastern lines, when he retired in 1955 after 52 years of continuous service with the railway.

Henry W. Preston (M. '07), age 88, retired plant engineer with the American Bridge Company in Elmira, N. Y., died in Pittsfield, Mass., on May 13. Mr. Preston received his civil engineering degree from Union College. He began his career as draftsman and designer with the Union Bridge Company in Athens, Pa. From 1901 until his retirement in 1939, he was plant engineer at the American Bridge Company's Elmira Plant.

Richard Quinn (M. '04), age 87, retired engineer of San Marino, Calif., died there recently. Mr. Quinn was a graduate of the University of Michigan and a veteran of World War I. He was in government service for many years. During the Spanish-American War, he was in charge of

(Continued on page 110)

Deceased

(Continued from page 108)

fortifications along the Mississippi River. He was also responsible for much work in Pacific Islands, having fortified Grandy Island in the Philippines and built break-waters in Hawaii. He reclaimed the first man-made beach at Waikiki.

George W. Rathjens (M. '19), age 77, consulting engineer of Berkeley, Calif., died there on April 22. Mr. Rathjens was a civil engineering graduate of the University of Illnois. He had served as assistant engineer with the Minneapolis and St. Louis Railway, and as chief consulting engineer with the U. S. Smelting, Refining, and Mining Company in Salt Lake City, Utah. He also had been in consulting practice for almost ten years. During World War II Mr. Rathjens was a colonel in the Corps of Engineers.

Guy P. Ridout (A.M. '47), age 46, assistant to the staff engineer at the White Sands Proving Grounds, N. Mex., died in El Paso, Tex., on May 18. Mr. Ridout, who had studied at the University of Louisville and the International Correspondence Schools, had been in the Corps of Engineers in Louisville, Galveston, San Juan, and New Orleans. Before joining the Ordnance Corps at White Sands, Mr. Ridout was an engineer for the International Boundary and Water Commission at El Paso and Laredo.

Daniel H. Seaman (A.M. '18), age 72, retired New York engineer, died in Essex Fells, N. J., on May 8. Mr. Seaman served for many years as chief engineer to the late D. Everett Waid, architect for the Metropolitan Life Insurance Company. In this position, he was responsible for checking the structural design of such structures as the Empire State Building and Rockefeller Center in New York City. He also was connected with the construction department of the New York World's Fair. Prior to his retirement in 1952, Mr. Seaman was with Parson, Brinckerhoff, Hall and Macdonald, New York consultants.

Arthur W. Tayman (M. '51), age 49, director of the Department of Public Works, Prince George's County, Md., died recently in Cheverly, Md. Mr. Tayman held B.S. and M.S. degrees in civil engineering from Johns Hopkins University. He had held the post of special assistant engineer with the Baltimore County Metropolitan District, and at the same time, was engineer of zoning for the county. He had been active in Maryland engineering organizations.

John W. Toyne (M. '22), age 79, retired engineer of South Bend, Ind., died there recently. Mr. Toyne, who was educated at the Armour Institute of Technology, had served as engineer in charge of construction and municipal improvements for both the J. L. White Company and the National Company. In private practice for many years, he had designed and built over 50 water-works plants for small communities.

William H. Vance (M. '16), age 81, retired railroad engineer of Louisville, Ky., died there recently. Mr. Vance, a graduate of the University of Illinois, had spent his career in railway work. He had served as assistant division engineer with the St. Louis, Iron Mountain, and Southern Railway and as division engineer with the Louisiana and Arkansas Railway where he was in charge of design, construction, contract work and maintenance of way. More recently he had been maintenance-of-way engineer for the Missouri Pacific Railroad at St. Louis.

Frank M. Weakley (M. '20), age 81, retired construction engineer with the Public Buildings Administration, died in Norfolk, Va., recently. Mr. Weakley was graduated from Iowa State College with a degree in mining engineering. As structural engineer for the Jamestown Exposition in 1905-1907, he was in charge of several million dollars of miscellaneous construction. He had been construction engineer with the U. S. Treasury Department and the Public Buildings Administration on projects in Cleveland, Buffalo, Ashland, Ky., and Little Rock, Ark. Mr. Weakley was an organizer and officer of the Virginia Section of ASCE.

Non—ASCE Meetings

Atoms for Peace. International Conference on Peaceful Uses of Atomic Energy, Geneva, Switzerland, September 1-13. Details from headquarters in Geneva.

Instrument Society of America. Automation Conference and Exhibit, Philadelphia, Pa., September 14-19. Details from Fred J. Taberry, Conference and Exhibit Manager, 3443 South Hill St., Los Angeles, Calif.

National Council of State Boards of Engineering Examiners. Annual meeting in Milwaukee, Wis., August 20-22.

Second National Conference on Applied Meteorology. Sponsored by ASCE and the American Meteorology Society, September 9-11, at the University of Michigan. Information available from D. J. Portman, Meteorology Laboratory, Civil Engineering Department, 304 West Engineering, University of Michigan, Ann Arbor, Mich.

New Publications

Multi-purpose river development . . . Availability of a study of the principal economic aspects of alternative policies for developing multiple-purpose river projects is announced by Resources for the Future, Inc. The second in a series dealing with specialized subjects in the resources field, the 184-page bulletin is concerned with methods of comparing the economic efficiency of different types of development, both public and private, and of estimating the effects of the alternative policies upon redistribution of income. By way of example, the new type of basic analysis is applied to two actual cases: Hell's Canyon on the Snake River and the proposed Coosa River development in Alabama. Economists John V. Krutilla and Otto Eckstein are the authors. The bulletin, which sells for $2.00, may be obtained from Resources for the Future, Inc., 1145 Nineteenth Street, N. W., Washington 6, D. C.

Stress analyses in soils . . . Investigations to determine the probable magnitude and distribution of stresses imposed in the soils beneath structures by their foundation loads are the subject of a significant paper by Prof. Donald M. Burmister, M. ASCE, of Columbia University. The paper—entitled "Stress and Displacement Characteristics of a Two Layer Rigid Base Soil System"—sells for 35 cents. Accompanying large-size Influence Diagrams and Practical Applications are 50 cents. Copies may be obtained from Prof. Donald M. Burmister, Department of Civil Engineering, Columbia University, New York 27, N. Y.

Drafting standards . . . A new tool of communication in drafting, providing uniform standards for the designer, manufacturer, and inspector, is available as Manual Y 14 of the American Standards Association. Experts claim that the use of the drawings in ASA Y 14 can save millions of dollars in single-plant, multi-plant, and subcontracting operations. Six sections of the manual (which will eventually contain 17) are now ready for use after ten years in development by a national committee, sponsored by the ASME and ASEE and operating under ASA procedure. Section 1—Size and Format, sells for $1.00; Section 2—Line Conventions, Sectioning and Lettering, $1.50; Section 3—Projections, $1.50; Section 4—Pictorial Drawing, $1.50; Section 5—Dimensioning and Notes, $2.00; and Section 6—Screw Threads, $1.50. Orders should be sent to the ASA, 70 East 45th Street, New York 17, N. Y.

Atomic energy . . . Several informative bulletins in the atomic energy field have been released by the Atomic Energy Commission. Titles and prices are: "Experimental Boiling Water Reactor," which sells for $2.00; "U.S. Research Reactors," listed at $1.50; and "Atomic Energy Facts," listed at $2.00. All may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Welding and cutting . . . A recent revision of the AWS-ASA Standard Z49 covers the entire field of safety in welding and cutting. Protection of personnel is emphasized and includes the precautions necessary when using the newer welding processes. Standard Z49 costs $2.00, and may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N. Y.

Airport construction . . . What airport planners need to know about the construction of airport aprons for handling turbine-powered aircraft is told in a new 57-page reference just published by the International Air Transport Association. Supplementing an earlier IATA reference based largely

(Continued on page 114)

NEW PUBLICATIONS

(Continued from page 112)

on experience with piston-engine aircraft, the new work includes data on blast from jet engines and means of counteracting blast effect. It is especially concerned with "planning the construction of the important part of an airport adjacent to the terminal building." The authors are a group of airline specialists working under the IATA Technical Committee. Orders will be filled, at 75 cents a copy, by the IATA Technical Secretariat, Terminal Center Building, 1060 University Street, Montreal 3, Canada.

Sewerage and drainage, New Zealand . . . The problem of collection, treatment, and disposal of the sewage and industrial wastes of the Auckland (New Zealand) Metropolitan Drainage District was the subject of a two-year study conducted by a group of United States and English engineers. Charles Gilman Hyde, Hon. M. ASCE, of Berkeley, Calif., was chairman of the Survey board, and John T. Calvert, M. ASCE, of London, England, vice-chairman. Findings and recommendations of the group have been put into a detailed final report, which supersedes an earlier preliminary report issued in July 1954. Inquiries should be addressed to C. C. Collom, Chief Engineer, Auckland Metropolitan Drainage Board, Auckland, N. Z.

Water supply, California . . . Information on all water systems in California having over 200 service connections is reported in a 55-page publication, entitled "California Domestic Water Supply Statistics." Data gathered by State Department of Public Health engineers since 1950 are included. Inquiries about the report should be sent to E. A. Reinke, Chief of the Bureau of Sanitary Engineering, California Department of Public Health, 2151 Berkeley Way, Berkeley 4, Calif.

Highway engineering . . . Availability of the first volume of the transcript of the highly successful Conference on Increasing Highway Engineering Productivity, held in Boston in September 1957, is announced by the Bureau of Public Roads. The present release, which includes Sections I-V, VII, and XIII, covers the use of electronic computation in expediting highway location and design; in bridge design and bridge geometrics; in traffic studies and research analysis; and the place of a computation division in the highway engineering set-up. Another section tells how to obtain the optimum value from photography and photogrammetry in highway engineering. Further information may be obtained from H. A. Radzikowski, Chief of the Division of Development, Office of Operations, Bureau of Public Roads, Washington 25, D. C.

Irrigation and drainage . . . The 1957 Annual Bulletin of the International Commission on Irrigation and Drainage comprises summaries of the 97 technical reports that highlighted the Third Congress on Irrigation and Drainage. Through its Irrigation and Drainage Division ASCE took part in the Third Congress, which was held in San Francisco in May 1957. The congress theme was "Water, Crops, Soils and Man in a Permanent Irrigation Agriculture." Copies of the Bulletin sell for 125 rupees, and may be obtained from the Secretary-General, Central Office, 1 Old Mill Road, New Delhi 1, India. W. A. Dexheimer, M. ASCE, U. S. Commissioner of Reclamation, has been elected president of the International Executive Council for a three-year term. Yadava Mohan, Chief of the Natural Resources Division, Planning Commission, Government of India, will be secretary-general for three years.

Topographic mapping . . . The status of both topographic mapping and aerial photography in the United States is indicated on an Index Map announced by the Map Information Office of the U. S. Geological Survey. The map shows areas covered by topographic quadrangle maps produced by the Geological Survey and other federal agencies and all areas known to have been photographed by or for federal, state, and commercial agencies. Inquiries should be sent to the Map Information Office, U. S. Geological Survey, Washington 25, D. C.

Brick masonry . . . A study on reinforced brick masonry—carried out by the Department of Engineering at the University of California in 1957—represents the second year of research conducted under the sponsorship of the State of California Department of Public Works. Tests to evaluate the influence of the rate of absorption of a brick on the strength of the bond developed between the brick and mortar were made by Jamal N. Habib. Non-destructive ultrasonic tests were the responsibility of David J. Leeds. Inquiries about the study, which is identified as Report 57-86, should be addressed to the Department of Engineering, University of California, Los Angeles, Calif.

Sanitary engineering . . . The Proceedings of the Twentieth Annual Short Course of superintendents and operators of water and sewerage systems—held at Louisiana State University in March 1957—have been made available as Bulletin No. 61 of the Engineering Experiment Station. Groups cooperating with Louisiana State in sponsoring the conference were the Louisiana State Board of Health, the Louisiana Conference on Water Supply and Sewerage, the Southwest Section of the American Water Works Association, and the Federation of Sewage and Industrial Wastes Associations. Bulletin 61 may be obtained from Prof. Fred H. Fenn, Director of the Engineering Experiment Station, Louisiana State University, Baton Rouge 3, La.

Russian science and mathematics . . . A leading Russian technical publication—the bimonthly "Journal of Applied Mathematics and Mechanics"—is being translated into English by the American Society of Mechanical Engineers. Under a $35,000 grant from the National Science Foundation, the ASME is undertaking the work to make the English-speaking world as conversant with Russian technical publications as Russian scientists and mathematicians are said to be with Western publications. The magazine contains the latest information on advances (theoretical and practical) made by Russian scientists in mathematics, fluid dynamics, and solid state physics. Copies will be sold, on a subscription basis, at an annual rate of $35 for the six issues. Orders should be placed through the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Highways . . . Another Bulletin in the Highway Research Board's series on Current Road Problems is now available in revised edition. Identified as No. 13-2R, the revised bulletin is devoted to the use of air-entrained concrete in pavements and bridges. It sells for 50 cents, and orders will be filled by the Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C.

Wood Research . . . Studies of nailed trussed rafters for industrial and farm structures—conducted in the Wood Research Laboratory at Virginia Polytechnic Institute—are reported by Prof. E. George Stern, M. ASCE, in the Laboratory's Bulletin No. 33. The investigation was sponsored by the Independent Nail and Packing Company, of Bridgewater, Mass. Inquiries about Bulletin 33 should be sent to Prof. E. George Stern, Wood Research Laboratory, Virginia Polytechnic Institute, Blacksburg, Va.

Earth science . . . Release of a selected annotated bibliography of the earth sciences is announced by the American Geological Institute. The bibliography—entitled "Earth for the Layman"—is designed to help teachers and students find helpful reading material in the fields of geology, mining, oil, and map-making. It is the second in a series aimed at interesting young people in science as a career. Copies of the publication, priced at $1.00 each, are available from the American Geological Institute, 303 AAAS Building, 1515 Massachusetts Avenue, N. W., Washington, D. C.

(Continued on page 121)

modern highways—

properly jointed to provide a greater and more economical service lifetime

"DESIGN PRACTICES" MANUAL AVAILABLE FREE OF CHARGE

This manual, entitled "Design Practices and Uses of Premoulded Joints in Concrete Pavements," features comprehensive technical data and illustrations of premoulded joint types, their applications and installation information. Send coupon today for your free copy.

The above highways, all properly jointed, were designed by forward thinking engineers for progressive state highway departments. Men who know that it pays to look beyond the initial cost, and design their highways to provide a greater and more economical service lifetime. Modern, properly jointed highways will help to reduce massive yearly maintenance costs. It will be to the advantage of every design engineer and state highway department to remember that dollars saved through reduced maintenance will provide miles of new highways for the same public expenditure.

INSTITUTE MEMBERS

The Celotex Corporation
120 South LaSalle Street
Chicago 3, Illinois

W. R. Meadows, Inc.
2 Kimball Street
Elgin, Illinois

Presstite-Keystone
Engineering Products Co.
3782 Chouteau Avenue
St. Louis 10, Missouri

Servicised Products Corp.
6051 West 65th Street
Chicago 38, Illinois

EXPANSION JOINT INSTITUTE

EXPANSION JOINT INSTITUTE
121 HILL AVENUE • AURORA, ILLINOIS
DEPT. 12

Gentlemen:

Please send me, without obligation, my free copy of "Design Practices and Uses of Premoulded Joints in Concrete Pavements."

NAME ____________________

FIRM ____________________

ADDRESS ____________________

CITY ____________ STATE ____________

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 W. 40th ST.	84 E. RANDOLPH ST.	100 FARNSWORTH AVE.	57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

Structural Engineer, A.M. ASCE, 22 years' experience in bridge and industrial design as well as four and one half years' of evening college instruction in structural design courses, seeks challenging work as assistant professor with engineering college in Metropolitan area of New York. C-347.

Civil Engineer, J.M. ASCE, B.S. and M.S. at M.I.T., 29, Registered P.E., State of New York. Experience in prestressed and reinforced concrete design, some steel design, some contract administration and field supervision. Married to teacher, her position desirable but not mandatory. Location desired. Overseas. C-348.

Civil Engineer, J.M. ASCE, B.S.C.E. (Structural), 25; two years' administrative military construction and design (USAF), seven months' highway design and construction; five months' aircraft structures; two months' coordination of design and construction of guided missile launching emplacements. Location desired, Southeast Michigan. C-349.

Engineering Administration, Teaching Or Consulting, A.M. ASCE, B.S. in C.E., M.S. in Sanitary Engineering, 45. Seven years' teaching in mechanics, hydraulics, and sanitary engineering; six years' of engineering administration of large municipal water treatment plant; one and one-half years' with consulting sanitary engineers. Five years' sales engineer. Registered Professional Engineer, Maryland and Washington, D.C. Location desired, East, Mid-Atlantic, South. C-350.

Civil Engineer, M.ASCE, 62, degrees, State licenses, 35 years' experience; design, construction and administration; bridges, parkways, thruways, airports, harbor works, railroads, underpinning and foundations. C-351.

Civil And Sanitary Engineer, A.M. ASCE, B.S. and M.S., 33. Structural design and analysis of reinforced concrete and steel structures. Design and supervision of design of large civic projects; water and sewage plants. Seven years' experience. Location desired, Middle or Near East. C-352.

Civil Engineer, A.M. ASCE, M.S. in C.E., 42, 14 years' experience as field engineer and superintendent in roads, bridges and tunnels, design and field. Seven languages. German passport. Seeks position as field engineer or superintendent. Location desired, U.S. or Foreign. C-353.

Sanitary Engineer, M ASCE; 47; B.A. (Chemistry) B.S. (Civil Engineering) C.E. (Sanitary Engineering), all degrees from University of Wisconsin; registered civil and chemical engineer in California; registered civil engineer, Illinois and Hawaii; Diplomate: American Academy of Sanitary Engineers; 22 years' of progressively important experience in all phases of sanitary engineering; at present as director of a sanitary engineering division in large government organization; desires change to U.S. in consulting or construction work; experience includes design, planning, management and direction of engineering staff. Will relocate as necessary to position. Available September 1958. C-354.

Construction Or Plant Engineer, J.M. ASCE, B.S. in C.E., 32, P.E. Ten years' experience in heavy industrial construction of steel, manufacturing and chemical plants including buildings, utilities, machinery, foundations, piping, etc. Supervision of engineering, estimating, specifications, contracts and construction. Location desired, Middle Eastern States. C-355.

Engineering Executive, J.M. ASCE, B.S. in C.E., M.S. in C.E., 33. Graduate Cornell University. Ten years' experience in steel and concrete detailing, structural design, sales and administration of industrial and commercial buildings. P.E. in Ohio. Position now as chief structural engineer for small concern. Location desired, East Coast area. C-356.

Chief Structural Engineer Or Project Engineer, M. ASCE, B.S., 55, Michigan graduate; registered structural engineer, Illinois; 29 years' designing and directing design of railroad and highway bridges, stores, power plants, steel mills, water filtration and chemical plants. Four years' as engineer on construction. Prefer temperate climate. C-357-9731-Detroit.

Civil Engineer, J.M. ASCE, 33, B.S. in C.E., M.S., registered Professional Engineer, married. Four years' construction experience at management level, five years' structural design of industrial buildings and bridges, steel and reinforced concrete. Seeks challenging position with general contractor, consulting engineer or architect. C-358-9725-Detroit.

Junior Engineer, J.M. ASCE, B.S. in C.E., 24. One years's experience in highway engineering mainly as proportioning engineer and paving inspector on concrete paving jobs. Registered engineer in training in Illinois. Pilot with USAF, two and one half years, commercial pilot's license. Location desired, Midwest. C-359-888-Chicago.

Civil Engineering Estimator; Cost, A.M. ASCE, B.C.E., 37, graduate, married, one child. Twelve years' diversified experience in design, planning, estimating, cost, construction in field and office. Also have certificate in business and finance and experience in business and securities, principles and operations. Desire opportunity to work for or with top management in responsible position. Location desired, New York City and vicinity. C-360.

Geological Engineer Consultant, J.M. ASCE, B.S.E. and M.S., 31. Seven years' experience ground-water supply exploration and development for municipalities and industries, hydrogeological aspects of nuclear energy plant site location and waste disposal, and engineering geology. Location, East. S-1454-San Francisco.

Positions Available

Civil Engineer, registered in state of Florida, with municipal engineering experience; must be capable administrator with engineering background; able to expedite projects and building programs; well acquainted with storm drainage, sewerage, streets, etc. Location, Florida. W-6110.

Highways Engineers with a minimum of three years' experience. Excellent opportunity with established consulting engineering firm. Location, Midwest. W-6117.

Application Engineer for water conditioning company. Experience in water and waste treatment required. Will be responsible for equipment selection and layout. Limited travel; opportunity for advancement. Apply by letter giving full details, salary requirements, etc. Location, Central-West. W-6127.

Structural Design Engineer to head up a department in the design of industrial and institutional type buildings. Should be well versed in application of design as related to both structural steel and reinforced concrete, etc., and should have a knowledge of foundation design. Salary, about $9,000 a year. Location, Virginia, W-6136.

Higway Designers, with considerable experience, some time of which has been spent in a consulting engineer's office. Also need highway and bridge draftsmen. Salaries: designers, $7,200-$7,800 a year; draftsmen, $6,000-$6,500 a year. Location, New England. W-6141.

Water Works Engineer, graduate civil, to head up engineering group for a water works pumping station. Will be required to maintain station reports, costs, main extensions, assignment of personnel, etc. Salary, $7,200-$8,400 a year. Location suburban New York. W-6144.

Instructor in structural design, civil or architectural engineer or Bachelor of Science, to teach structural design and related subjects in an architectural school. Should have strong interest in architecture, a professional license and several years' experience in the design or construction of buildings. Can continue private engineering practice. Location, New York area. W-6161.

Superintendent, 28-32, degree in civil engineering or architecture, with strong construction experience, preferably involving multi-story reinforced concrete frames. Outstanding management ability and potential. Position involves complete general contract responsibility at the site of the work for construction of a multi-story reinforced concrete frame apartment building, including layout and supervision of sub-contract trades. Apply by letter giving complete details including salary requirements. Location, northern New Jersey. W-6174.

Designer-Draftsman on building construction, about 30, but will consider older man, graduate engineer or architect with five years' experience in the design of structural steel and concrete, heating, plumbing and air conditioning for industrial and public buildings, drafting, specifications, etc. Must intend to qualify for New York State Professional Engineer or Registered Architect's license. Salary, to $7,000 a year. Location, New York State. W-6177.

Engineers for supervision of construction contracts for major hydroelectric project, transmission lines, irrigation works, industrial plants, gas pipe line, as well as engineering surveys and investigations. (a) chief engineer. (b) construction engineer. (c) project engineer. (d) field engineer. (e) office engineer. Two-year contracts, prospective renewals. Transportation and medical hospital insurance includes families. Location, Far East. F-6189.

Technical Service Engineer, graduate civil, 24-30, for technical field work with customers of major cement producer. Salary open, expenses, company car. Location, East. W-6212.

Teaching Personnel for Department of Civil Engineering, postgraduate training preferably at the Ph.D. level and some design experience. Will teach in the fields of fluid mechanics, soil mechanics and general engineering. Rank and salary commensurate with qualifications. Location, Pacific Northwest. W-6225.

Applied Mechanics, to 35, B.S. in civil or mechanical engineering, with elective courses in advanced strength of materials, machine design and fibration. Minimum of five years' in machine design and machine development or teaching involving the study and testing of structures, machines and pressure vessels. Company pays placement fee; relocation expenses, etc. Location, East. W-6227(c).

Corrective Maintenance Engineer, for an engineering service division; 30-35, graduate mechanical, civil or metallurgical, with seven to ten years' experience at plants or in central engineering specializing in mechanical equipment problems or mechanical improvement. Company pays placement fee; relocation expenses. Location, East. W-6228(a).

Cost Engineer, graduate civil or mechanical, with a minimum of five years' experience in chemical or oil refinery construction costs. Ordinary estimating experience will not be satisfactory. Salary, $9,600 a year. Location, New York, N. Y. W-6233.

Management Engineer, not over 55, engineering background, preferably in construction or architectural engineering, to program and expedite major construction activities. Will supervise engineers, draftsmen, designers and specification writers, coordinate with interest professional groups and supervise construction after construction has been let to contractors. Salary, $12,900 a year. Location, East. W-6234.

Sanitary Engineers, graduates, to deal with sanitary engineering, public health and sanitation problems such as water systems, their design, construction and operation, chemical and bacteriological analyses; design and construction of sewage disposal; other health aspects of housing environment. Must have ability to direct and coordinate professional engineering problems in connection with technical research, design, development, planning or comparable functions. Salaries, $8,645 a year. Locations, Milwaukee, Chicago and Minneapolis. W-6238.

Resident Construction Engineer, graduate civil or chemical; must be a Canadian citizen, under 55, with experience in chemical plant or oil refinery construction. Salary, to $10,000 a year. Location, Canada. F-6239.

Associate Professor, Assistant Professor Or Instructor to teach highways, highway materials and other civil engineering subjects. M.S. or Ph.D. preferred but B.S. degree considered. Rank and salary dependent upon qualifications. Appointment available immediately, or September 1958 or January 1959. Location, Midwest. W-6256.

Positions Announced

Philadelphia District, Corps of Engineers. Vacancies for Civil Engineers with salaries from $5,335 to $8,645 a year, depending on qualifications. These openings come under Civil Service system and interested applicants should submit resumés to the Philadelphia District, U. S. Army Corps of Engineers, Philadelphia, Pa.

U. S. Navy. Civil Engineer (GS-9) wanted. Location, Mare Island Naval Shipyard, Vallejo, Calif. Applications should be sent to Employment Superintendent, Code 172, Vallejo, Calif.

Washington State Department of Health. Two openings, one in Seattle and one in Spokane, for Senior Public Health Engineers. Will conduct surveys and investigations and assist the head of the sanitary engineering section. Applicants must be college graduates, with either one year of graduate study or one year of engineering experience in sanitary or public health, in addition to three years of experience in the field. For further information, and application forms, contact Washington State Personnel Board, 212 General Administration Bldg., Olympia, or 317 Smith Tower, Seattle 4, Wash.

NEWS OF ENGINEERS

(Continued from page 24)

M. H. Cutler has been promoted to assistant engineering manager for the Stone and Webster Engineering Corporation, Boston, Mass. Mr. Cutler has been with the company since 1923, most recently as

M. H. Cutler — R. M. Jacobs

chief structural engineer. Taking over the post of chief structural engineer is **Robert M. Jacobs,** formerly assistant to Mr. Cutler. Mr. Jacobs has been with Stone and Webster for 17 years.

Three ASCE members of the faculty of the Civil Engineering Department at the University of Illinois have been named winners of the 1958 Epstein Award. They are **William J. Hall,** professor of civil engineering, and secretary of the Central Illinois Section; **John D. Haltiwanger** and **John W. Hutchinson,** instructors in civil engineering. Donors of the award are a family of ASCE members, **Abraham Epstein** and his sons, **Raymond** and **Sidney,** all university alumni.

Kurt Billig has taken the post of chief engineer for the development of nuclear power stations with Taylor Woodward Construction, Ltd., in London. Before his new appointment, Dr. Billig had served with the United Nations Technical Assistance Administration as consultant to the government of Pakistan.

Dr. K. Billig

Robert D. Monical and **Clair K. Wolverton** announce the opening of a new office building for their consulting firm, Monical and Wolverton. The new building is at 1718 West Fifteenth Street in Indianapolis, Ind.

Guy Kelcey, pioneer traffic engineer, has been honored with the honorary degree of doctor of engineering from the Newark College of Engineering. Mr. Kelcey, since 1946, a partner in the Newark consulting firm of Edwards and Kelcey, has made significant contributions in the field of traffic engineering. The citation read at the exercises honored him for his "outstanding record as an engineer dedicated to solving some of the most complex and perplexing transportation problems of our age . . ."

Guy Kelcey

Solomon C. Hollister, dean of engineering at Cornell University for 21 years, was the recipient of the honorary degree of doctor of engineering from Lehigh University during the recent commencement exercises. Dean Hollister has served with several committees of Engineers' Council for Professional Development, including the chairmanship of the Education Committee and of the Committee on Adequacy and Standards. He is a past president of the American Society for Engineering Education and a former Director of ASCE.

Advance Information on Attendance

JOINT MEETING ASCE and IABSE

ASCE CONVENTION

NEW YORK

OCTOBER 13-17, 1958

I plan to attend sessions ☐ Mon. ☐ Tues. ☐ Thurs. ☐ Fri.

Do you plan to attend the ASCE-IABSE Luncheon on Tuesday? ☐ Yes ☐ No

Send to Professor James P. Michalos, Chairman, Department of Civil Engineering, New York University, University Heights, New York 53, N. Y.

Signature..........................

NEW PUBLICATIONS

(Continued from page 114)

Concrete pipe . . . Indispensable to the designers and users of concrete pipe are two recent publications of the American Concrete Pipe Association. A 500-page revision of the "Concrete Pipe Handbook" provides engineering data and technical information, which are not readily available in any other single reference. The present fifth edition incorporates ASTM's new Tentative Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe. It also includes latest information on the hydraulics of pipelines and on load-bearing calculations for culverts. The other publication, entitled "Fiftieth Anniversary History," is a factual but highly interesting account of the first fifty years in the life of the Association. Howard F. Peckworth, Director of ASCE and managing director of the American Concrete Pipe Association, is author of the Anniversary History and directed the revision of the Handbook. Both volumes may be obtained from the American Concrete Pipe Association, 228 N. La Salle Street, Chicago, Ill. The Handbook is priced at $8.00 a copy, and the Fiftieth Anniversary History at $6.00 a copy.

Aluminum in building . . . A bright future for aluminum in modern architecture is forecast in an 118-page illustrated publication, which is being distributed by the Reynolds Metal Company. The present study, entitled "Aluminum in Modern Architecture, 1958," supplements an earlier two-volume work issued by the company. The new work features studies of twenty-five recently completed buildings—eight of them in the United States—that make extensive use of aluminum. Among other highlights are the first detailed report of the recent West Berlin conference on aluminum in international architecture and a summary of the progress of aluminum as a building material. The reference is available to architects and engineers from the Reynolds General Sales Office in Louisville, Ky.

Florida offshore lands . . . Considerable acreage in Florida is state-owned (deeded to the state by the "Swamp and Overflowed Lands Act" of 1850) and must be purchased from the proper agency. For the benefit of engineers and others needing to know the application procedures for buying such lands, the Florida Engineering Society is making available as Reprint No. 5 an article from the February 1958 issue of its "Journal." Limited copies are available from the state headquarters of the Florida Engineering Society, 114 S. E. First Street, Gainesville, or from the author of the article, Jon S. Beazley, A.M. ASCE, 1903 N. Monroe Street, Tallahassee.

Steel bridges . . . Suggestions for simple and economical planning for the thousands of bridges that will be needed on the proposed 41,000-mile Interstate Highway network have been assembled and published by the American Institute of Steel Construction. The 32-page, two-color brochure is divided into two sections. The first covers the economy and aesthetics of steel, welding, high-strength bolting, structural low-alloy steels, erection, steel decking, and composite design. The second gives examples of solutions that have been used for some of the more troublesome problems encountered in steel bridge design. Free copies of the booklet may be obtained from the AISC, 101 Park Avenue, New York 17, N. Y.

Reinforced concrete . . . Approval of the ultimate design method by the American Concrete Institute constitutes a major step forward in achieving realistic designs in reinforced concrete structures, according to the Portland Cement Association. As an aid to engineers acquainting themselves with the method, the Association has made available an authorized reprint of the Proceedings of a Symposium on the Strength of Concrete Structures (presented in London in May 1956). The reprint—entitled "Ultimate Strength of Reinforced Concrete in American Design Practice"—discusses the background and present usage of this design method. Eivind Hognestad, A.M. ASCE, is the author.

RECENT BOOKS

(Added to the Engineering Societies Library)

Air Pollution

The aspects dealt with include the character and consequences of air pollution; dispersion of discharged gases; legislation; elimination of pollution caused by domestic heating, vehicle exhaust fumes, and industrial boilers and equipment. The book, edited by M. W. Thring, is based on papers given at a conference at the University of Sheffield, September 1956. (1957, Butterworths Scientific Publications Ltd., London, England; Butterworth & Co. (Canada) Ltd., 1367 Danforth Avenue, Toronto 6, Ontario. 248 pp., $8.50)

Design Of Concrete Structures

Sixth Edition

This volume covers the entire field of customary reinforced concrete with minor exceptions. Complete designs of more common structures are given, along with a thorough discussion of basic structural performance and fundamental mechanics. In this edition by Leonard C. Urquhart and others, an entirely new, extensive section is devoted to ultimate strength design, and provides not only detailed design procedures but also gives substantial theoretical background. (1958, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 546 pp., $8.00.)

Fluid Mechanics

Second Edition

Beginning with the fundamental equations and concepts of fluid mechanics, Victor L. Streeter continues with their applications to flow measurement, hydraulic machinery, pipe systems, and open-channel flow. The principles of control sys-

tems and oil hydraulics are also discussed. This edition has been extensively revised to include new material on fluid properties, dimensional analysis and dynamic similitude, compressible flow, and negative surge wave treatment. (1958, McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 36, N. Y. 480 pp., $7.50.)

International Association For Bridge And Structural Engineering: Publications Volume 17, 1957

This collection of papers deals with a variety of bridge and structural engineering problems such as the impact resistance on prestressed concrete masts, a general theory of deformations of membrane shells, a theory of prismatic folded plate structures, influence surfaces for moments in continuous slabs over flexible cross-beams, and stress and strain in thin shallow spherical calotte shells. (Published 1958 for the Association by Verlag Leeman, Zürich, Switzerland. 268 pp., 38 DM.)

Nuclear Reactor Experiments

The staff of Argonne National Laboratory outlines problems relating to the design, construction, and operation of nuclear reactors with details of equipment and experiments. Areas included are nuclear radiation detection, moderator and subcritical assemblies, cross sections, operating reactors and their characteristics, heat removal from a reactor, corrosion and radiation effects, fuel preparation, and separation processes. (1958, D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J. 480 pp., $6.75.)

Programming For An Automatic Digital Calculator

Kathleen H. V. Booth illustrates the processes of programming by reference to automatic digital computers now in use. Aspects dealt with include input and output, division and square root, non-arithmetic programmes, matrix operations, simultaneous linear equations, mechanical translation, an interpretive programme for decimal tapes, interpretive routines and pseudo-codes, fault finding, and automatic programming. (1958, New York, Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y. 238 pp., $7.50.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Applications for Admission to ASCE, April 28-May 31

Applying For Member

Wallace Hale Alexander, Harrisburg, Pa.
Jack Borough Bayley, Port of Spain, Trinidad.
Glenn Allen Beecham, Clinton, Okla.
Jacques Louis Bessiere, Richmond, B.C., Canada.
Floyd Bishop Bothwell, Piedmont, Calif.
Constantin Papa Constantinu, Republic of Venezuela.
William Anderson Cunningham, New Orleans, La.
Donald Alfred Daly, Millbrae, Calif.
Robert William DeLozier, Aiken, S. C.
William Nevin Dripps, Falls Church, Va.
George Yuan Ewart, Waipahu, Oahu, T. H.
Mal Gogel, Syracuse, N. Y.
Raymond Henry Haas, Vicksburg, Miss.
Collin Hunter Handforth, Sutter, Calif.
Llewellyn Gilmore Haskell, Salt Lake City, Utah.
George Ronald Hayes, Indianapolis, Ind.
Huai-yun Hsu, San Francisco, Calif.
Walter James Hutchin, Norfolk, Va.
Homer Brinson Hutchinson, Jr., Decatur, Ala.
Melvin Andrew Jabara, Denver, Colo.
Clarence Sadao Koike, Kekaha, Kauai, Hawaii.
Oliver Hawes Kollock, Plainfield, N. J.
Clement Alphonso Konwinski, Aiken, S. C.
Alfred Korsen, Englewood, N. J.
Edmund Mitchell Kowkabany, New York, N. Y.
David Victor Lewin, Cleveland, Ohio.
Francis William Madison, Toronto, Ont., Canada.
Edward Theodore Marsh, Glenside, Pa.
Sidney Russell Marshall, Frankfort, Ky.
Ralph Earl McMullen, Portland, Ore.
John James Meyer, Philadelphia, Pa.
Charles Joseph Monahan, Walla Walla, Wash.
Leon Phillip O'Connor, New York, N. Y.
Ernest Francois Marie Pariset, Montreal, Que., Canada.
Albert William Redman, Denver, Colo.
Albert Salibian, Los Angeles, Calif.
Abe Silverstein, Cincinnati, Ohio.
Edward Powell Smith, Delaware, N. Y.
Aloys Henry Sprick, St. Louis, Mo.
Mysore Srinivasan, New Delhi, India.
John Noel Storrs, Honolulu, Hawaii.
Robert Jacob Strass, Milwaukee, Wis.
Harry Percival Theus, Portland, Ore.
Richard Glen Thomas, Los Alamos, N. M.
Frederick Lyle Walker, Lexington, Ky.
Walter Johnson Wells, Fort Worth, Tex.
Francis Leo Witkege, Washington, D. C.
Robert Joseph Wolf, Oakland, Calif.
Charles William Zahler, Pittsburgh, Pa.

Applying For Associate Member

Lowell Leroy Alford, Portland, Ore.
Manley Bennett Azrikan, Los Angeles, Calif.
Charles Robert Bacon, Royal Oak, Mich.
Robert Winston Bothwell, El Paso, Tex.
Charles Alexander Brallier, Van Nuys, Calif.
John Brown, Niagara Falls, Ont., Canada.
Richard Dale Eryie, Aiken, S. C.
John Alvin Burke, Bethlehem, Pa.
Newsom Brooks Caraway, Houston, Tex.

(Continued on page 123)

APPLICATIONS

(Continued from page 122)

James Henry Carney, Rialto, Calif.
Simeon Ray Cason, Olympia, Wash.
Chia-Tsun Chen, Hayward, Calif.
N. K. Chengappa, Madras, India.
Harold Wayne Conner, Skokie, Ill.
Joseph David, Harrisburg, Pa.
Salvatore Vincent DeSimone, Ardsley, N. Y.
Fred Ballantyne Dunn, Jr., Port Neches, Tex.
Cecil Archdale Edwards, Wollingong, N.S.W., Australia.
Peter David Ellesmere-Jones, Los Angeles, Calif.
Guy Francis Emerson, Park Ridge, Ill.
Robert Irving Geyer, Prospect, Ill.
Hans Gram, Atlanta, Ga.
Harold Bradstock Robertson Graves, Vancouver, B. C., Canada.
Oscar Robert Grothe, Wisconsin Rapids, Wis.
Carleton Henry Heinke, Portland, Ore.
William Charles Holstein, Bridgeville, Pa.
John Richard Hunter, New South Wales, Australia.
Edward Alexander Hutt, Vancouver, B. C., Canada.
William Singleton Hyde, Sacramento, Calif.
Eugene Alois Jarecki, Denver, Colo.
Carl Ray Johnson, Saigon, Sud-Viet-Nam.
Ralph Richard Johnson, Evanston, Ill.
Arthur Curtis Jordan, Dallas, Tex.
George Arthur Kaufmann, Sacramento, Calif.
James Howard Kearney, London, Ontario, Canada.
Jamie Hastings Kerr, Jr., Houston, Tex.
Herbert Oswald Klossner, West Allis, Wis.
Robert Mather, Warwickshire, England.
Thomas Grant Miller, IV, Ithaca, N. Y.
David Berchmans Minch, London, S. W., England.
Donald Harold Olson, Minneapolis, Minn.
Robert Frederick Piest, University, Miss.
Alamengada Aiappa Raju, Chicago, Ill.
James Lawrence Ray, New York, N. Y.
Murray William Sedgley, Muscatine, Iowa.
Arthur Gerald Sherman, Los Angeles, Calif.
Pantelis Siderides, Athens, Greece.
Rodney Howe Smith, Champaign, Ill.
Laszlo Szerdahely, Budapest, Hungary.
Lorraine Ola Transtrum, Sacramento, Calif.
Pieter Roux Van Zyl, Evanston, Ill.
Manoje Watanatada, New York, N. Y.
Jack T. Walle, Northport, N. Y.
Frederick Horace Weals, China Lake, Calif.
Seth Day Woodruff, Los Angeles, Calif.
Howard Burton Woody, Great Falls, Mont.

Applying For Affiliate

Charles Maxwell Gilliss, Sacramento, Calif.

Applying For Junior

Holenarasipur Nanjappa Anand, Mysore State, India.
Lloyd William Curry, Grand Junction, Colo.
John Owen Gavin, Memphis, Tenn.
Ralph Emerson Gerhart, Jr., Mishawaka, Ind.
Luther William Graef, Milwaukee, Wisc.
Lars Ingmar Gullstrom, New York, N. Y.
Charles Stewart Hedges, Atlanta, Ga.
Harold Rex Honeyfield, Albuquerque, N. Mex.
Roland Wallace Hudson, Birmingham, Ala.
Kenneth Earl Holford, Rochester, N. Y.
Frank Grant Jones, Louisville, Ky.
Robert Christopher Lunardini, Chicago, Ill.
Jean Lord, Montreal, Que., Canada.
Le Wu Lu, Bethlehem, Pa.
Cary Burton Mason, Newport News, Va.
Joseph Matts, Cleveland, Ohio.
Edwin Walter Meredith, Ocala, Fla.
Charlie Robertson Mitchell, Morgantown, W. Va.
Pedro Francisco Mora Mena, Santurce, Puerto Rico.
Islam Nabi, Karachi, Pakistan.
Sathyagala Suryanarayana Jois Nagaraju, Mysore, India.
William Earl Oxenreider, Charleston, W. Va.
John Keithley Parsons, Culver City, Calif.
Thomas Lee Peacock, Minneapolis, Minn.
Venkatachala Setty Pendakur, Vancouver, B. C., Canada.
Ervin Sewell Perry, Fort Belvoir, Va.
Warren Pfefferle, Norfolk, Va.
Donald Paul Ryan, East Lansing, Mich.
Kanu Shantilal Shah, Austin, Tex.
Laxmidas Dahyabhai Shah, South Bend, Ind.
Edward Harris Small, Jr., Augusta, Me.
George Spitz, New York, N. Y.
James Kenneth Stangenberg, San Francisco, Calif.
Asher Ely Stutman, Philadelphia, Pa.
Tsu-Ming Yang, Champaign, Ill.
Jose Zayas-Green, Los Angeles, Calif.

[*Applications for Junior Membership from ASCE Student Chapters are not listed.*]

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Low-Priced Chlorinator

A PNEUMATIC CONTROL CHLORINATOR which automatically proportions chlorine flow to primary flow and costs substantially less than similar units has been developed. It uses a compact Ratio Relay Assembly which may be mounted either on the wall or on top of the chlorinator. Serving as a dosage adjustment, it receives a 3-15-psig linear signal from the flow transmitter and transmits another 3-15-psig signal to the chlorinator's pneumatic rate valve. The output signal from the ratio relay unit is maintained at an adjustable preset ratio to the input signal. The chlorinator can be used also as the final control element in a residual chlorine control setup. Used thus, the chlorinator's pneumatic rate valve is operated by a 3-15-psig signal transmitted directly from a residual chlorine analyzer located downstream from the chlorinator. **Fischer & Porter Company, CE-7, 693 Jacksonville Road, Hatboro, Pa.**

Backhoe Attachment

AN 8-FT BACKHOE attachment with two bucket capacities for use with the highly versatile Speed Swing loader, is now available. The 18-in. bucket has a ⅜-yd capacity; the 24-in. bucket has ½-yd capacity. The backhoe digging depth is 8-ft 6-in. and the surface reach is 12-ft 6-in. from front of tires. The loading height, from tires, is 11-ft. The Speed Swing has an exclusive 180-deg boom swing—90-deg right and left. Other attachments now available are forks, crane hook, 18-ft boom extension, clamshell and backfiller blade. The machine is quickly and easily converted from a backhoe back to a bucket loader, or fitted with another of the many attachments available for it. **Pettibone Mulliken Corp., CE-7, 4700 W. Division St., Chicago 51, Ill.**

Tractor Type Crawler

THE PIPELINER AND OTHER hoe users are offered a track that not only gives longer service, but also requires less maintenance. Overall width of the tractor type crawlers with 20-in. wide shoes is 9-ft 5½-in. Overall length of the standard size crawler is 12-ft. Two speed independent traction is optional on the 305 Hoe. Maximum digging reach of the 305 model is 31-ft. Depth obtainable with the machine is 19-ft 9½-in. The clearance height at maximum dumping height of the ¾-yd dipper is 25-ft 2½-in. Clearance height at the beginning of the dump is 12-ft 10-in. This is increased to 18-ft 7-in. at the end of the dump. **Koehring Division, CE-7, Milwaukee 16, Wis.**

Trench Filler & Shoulder Spreader

A NEW MACHINE, DESIGNED specifically for the filling of road widening trenches and spreading of shoulder material, has been developed. The T40 Trench Filler and Shoulder Spreader is an attachment for Caterpillar Motor Graders, and can be attached or detached in less than 10-min, with just three bolts and one pin making the connection. It is equipped with an angling strike-off blade which can be adjusted to spread from 1 to 10-ft wide. Minor width variations of from 1 to 24-in. are made by simply rotating the grader circle. Width changes greater than 2-ft are accomplished by removing or adding 1-ft blade sections. The long wheelbase of the motor grader provides the stability necessary to overcome the sidedraft set up by the extra length strike-off blade. Spreading depth is independently power controlled on both ends of the strike-off. The pavement end is raised or lowered with a double acting hydraulic cylinder and, the outer end, with the grader blade lift mechanism. The blade can be set at any point 16-in. below or 8-in. above the pavement. The hopper is all electric-welded from high tensile steel and the torque tube and box section main frame is an integral part of the hopper. The large torque tube also serves as the reservoir for the hydraulic system. **Ulrich Manufacturing Company, CE-7, Roanoke, Illinois.**

T40

Automatic Welding

A SEMI-AUTOMATIC SUBMERGED arc welder, using a special alloy flux, produced full strength welds in beams fabricated of T-1 high tensile steel. Welding speeds were three times as fast as manual welding. The John F. Beasley Construction Co., steel erectors, recently fabricated six large beams, each over 75-ft long, and several shorter, but equally wide. The flanges on the heaviest beams were 2-in. thick and 16-in. wide, with webs that were 1¼-in. thick and 62-in. high. The webs were made of T-1 steel and it was desired that the welds have properties comparable to those of the steel. The length and size of the welds made submerged arc welding desirable because of its speed and high deposition rate. Working with The Lincoln Electric Co., Beasley obtained a special submerged arc flux that, when used with a standard mild steel electrode, produced deposits with the desired properties. Alloys from the flux mixed with the mild steel electrode in the molten pool under the arc and formed the alloy deposit. **The Lincoln Electric Co., CE-7, 22801 St. Clair Ave., Cleveland 17, Ohio.**

Double Action Screed

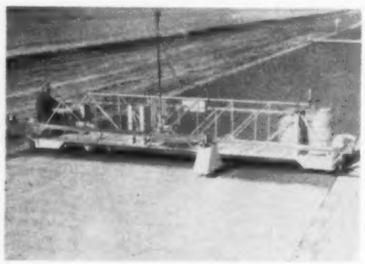
A NEW DOUBLE ACTION screed that attaches easily and quickly to the back of any standard dump truck has been developed. This makes a spreader out of any dump truck and can be used for asphaltic concrete, pre-mix, cliche base, gravel and many others. The double action gives a highly compact uniform layer and is the economical answer to the spreading problem. **Browning Manufacturing Company, CE-7, San Antonio, Texas.**

Geodesic Structure

A CONTRACT FOR CONSTRUCTION of a giant geodesic space lattice dome has been awarded to the Columbus Division of North American Aviation, Inc. It will be a major architectural highlight of the new American Society for Metals building, to be built 35 miles east of Cleveland, Ohio. The structure will be 250-ft in diameter and 103-ft high. It will be composed of 11-ft aluminum hexagon sections lending the appearance of open end honeycomb. Geodesic, meaning earth-form, consists of the structure assuming the shape of a half-sphere. The space lattice method is a new mode of construction, and possesses great strength to easily withstand the forces of nature. Weighing approximately 200,000-lb, the space lattice will be supported by five pylons. Two of them descend inside the dome into the court and provide support for the headquarters building, which will be built on three levels in a 168-deg semi-circle. On the third level's west side, copper screens will be utilized to further demonstrate metal uses and to facilitate clear vision in the glare of the setting sun. Housed in the structure will be office accommodations for the 90-member staff of the Society. In addition, there will be assembly and conference rooms, a dining room, library and chapel. **North American Aviation, Inc., CE-7, Columbus 16, Ohio.**

Membrane Curing Machine

A NEW CONCRETE CURING compound spray machine, featuring a synchronized automatic adjustment of the spray stroke to produce a more uniform and economical spray pattern, has been developed. The angle of the spray stroke is pre-set and its speed automatically synchronized with the forward speed of the machine to produce a spray pattern that is accurately perpendicular to the side forms. At the end of each stroke the angle of the spray stroke is automatically reversed to maintain a spray path even with the previous one. The new product is said to meet specifications while saving 25 to 30% in curing compound consumption. This economy is accomplished by the more efficient spray pattern and through elimination of wastage which usually occurs at the end of a spray stroke. The angle of wheels on both sides of the machine can be adjusted instantly while in motion to steer the rig against drifting off side forms on super elevated curves, or when operating with rubber tires on pavement. Travel speed is variable up to 15-ft per minute. Width of the standard model is adjustable from 24-ft to 25-ft. Special sizes can be produced to any width up to 36-ft. **Concrete Machinery Ltd., CE-7, 9530 E. Rush St., El Monte, Calif.**



Speed Automatically Synchronized

Double-Swivel Airslide

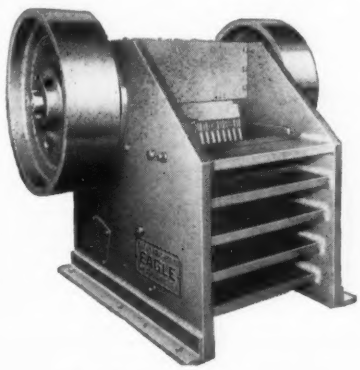
TIME AND LABOR SPENT in positioning a bulk materials discharge point above multiple receiving inlets have been eliminated by a double-swivel Airslide fluidizing conveyor which feeds an unlimited number of locations within its scope of movement. Comprising two lengths of Airslide sections coupled together in a double-swivel system, the unit is easily maneuvered by one man from one discharge point to another. Available in all standard sizes and capacities, the Airslide conveyor will handle dry, pulverized, crushed and granular material pneumatically in bulk. Utmost flexibility is offered wherever a problem in space and clearance exists for loading either railroad cars or trucks. Permanently set up at the primary bulk delivery point, the Airslide can be folded back out of the way when not in use. It can be employed as an isolated unit or as part of an integrated system. The conveyor comprises parallel upper and lower chambers separated by a special gas permeable diaphragm. Air under low pressure, which is passed from the lower chamber through the special diaphragm, partially fluidizes the material in the upper chamber, reducing friction and giving it some of the characteristics of a liquid so that it flows under the force of gravity. In the double-swivel system, the discharge end of one Airslide length is hinged on a common shaft with the inlet end of the other. Material thus passes by gravity into the second, while at the same time the discharge end of the second can be swung nearly a full 360-deg. **Fuller Company, CE-7, Catasauqua, Pa.**

EQUIPMENT MATERIALS and METHODS

(continued)

Jaw Crusher

According to the manufacturer's statement, this jaw crusher with a 30-in. x 42-in. feed opening will serve in many cases as a primary crusher. The rated capacity is 125 to 400 tons per hour. Overall weight of the crusher alone is 55,000-lb. It requires a 125-150-hp motor to attain and hold normal operating speed of 200-rpm. Other features include



Overall Weight—55,000-lb

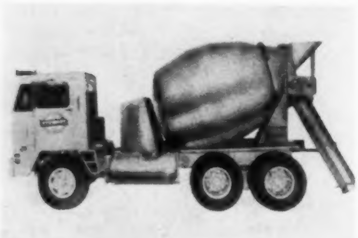
a 58-in. fly-wheel, reversible jaws of manganese steel, special bearings and special alloy steel in eccentric shaft. Safety toggle seat of Pitman is replaceable and crusher jaws are adjustable (while operating) from a minimum of ½-in. to a maximum of 8-in. This crusher tops the company's line of jaw crusher, hammermills, and cage mills, both stationary and portable. **Eagle Crusher Company, CE-7, 1000 Harding Way, East, Galion, Ohio.**

Nylon Truck Tire

Named the FWT-2, this tire is specially adapted for use on front wheels of concrete ready-mix trucks and high volume stone and gravel haulers, where the axle is heavily loaded and short turns with power steering are common. Truck owners may also use the tire on drive and trailer wheels for similar heavy duty. The tire can be operated at normal speeds in local highway use. It has three wide ribs designed to resist edge tearing and a tread radius which gives good forward and lateral traction. The design reduces the tendency for stones to catch in tread grooves and cleaning edges. **The Goodyear Tire & Rubber Co., CE-7, Akron, Ohio.**

Hydraulic Powered Concrete Mixer

THE 7 YARD STEWART "Hydramix" Hydraulic Powered Concrete Mixer is now being marketed. According to the manufacturer, this is the first practical, working hydraulic truck-mounted mixer. By using a hydraulic oil pressure system to rotate the mixer, the "Hydramix" eliminates conventional mechanical linkages such as control rods, levers, cranks, chains and sprockets. The company spokesmen were quoted as saying that this means greater simplicity of operation, reduced wear and expense, a shorter wheelbase, lower center of gravity, and less weight than with conventional mixers. The hydraulic system reduces shock loads and overloads. Simplified control of the mixer is a special new feature. Three controls are conveniently mounted together on a panel on the rear support: a relay switch to control the drum, a hydraulic valve to position the chute, and a valve to control the water. Another feature is the pressurized water system, for providing water for additions to the mix and for cleaning the drum and chutes. **American Pozzolan Company, CE-7, P. O. Drawer 1431, Duncan, Oklahoma.**



Simplified Control

Sand Separator

A NEW METHOD OF removing sand and silt from water is being introduced to the market. With sand removal efficiencies close to 100%, the Cole Sand Separator is designed for use by food processing and chemical industries, and municipal systems requiring automatic valving and other hydraulic components subject to fouling from small sand or silt particles. It is the first to use a two chamber system—one to separate heavier particles through a centrifugal-helical action utilizing water at high velocity, and one to separate residual fine particles by reducing the water velocity below the "fall out" velocity of the very fine particles. Virtually complete sand removal is attained with little pressure drop (2 to 4-psi) and large gpm fluctuations have no effect on efficiency. The separator's reduced size and weight offer savings in manufacturing, shipping, installation and maintenance costs. Sand-laden water enters a volute which forces water into a helical-centrifugal path while increasing its velocity. Solid particles are forced to the outer periphery of the volute where they are allowed to escape into the settling area. Sand-free water continues upwards in its helical path toward the outlet. As velocities are slowed, any residual particles gravitate to a dividing plate where they are washed outward and down into the settling area through a slot at the edge. Accumulated sand can be discharged (usually two to three weeks) through a bottom control valve. **Walter R. Cole & Co., CE-7, 1414 Third St., Oakland, Calif.**

EQUIPMENT MATERIALS and METHODS

(continued)

Crane Hook

THE MODEL B CRANE HOOK that opens and closes pneumatically and is trigger actuated has been announced. This heavy-duty hook, with a capacity of 12 tons, is especially designed for handling 2, 3, 4-cu yd concrete buckets and is also useful for other lifting work. The crane operator simply lowers the hook so that the mechanical trigger within the hook circle contacts the bucket bail, which actuates the ratchet type air valve that controls the opening or closing of the hook. Overlapping lifting tongs provide an important safety factor; the hook cannot open under any load. Integral guide arms assure easy hooking. The need for a hook-on man is eliminated and crane efficiency is increased because the operator can make more lifts per hour. **Gar-Bro Manufacturing Company, CE-7, 2415 E. Washington Blvd., Los Angeles, Calif.**

Heavy-Duty

Warning Flag

"SAFLAGS", A NEW, MORE versatile type of barricade and truck warning flag that can be seen by night or day, is made of 100% ingrain nylon material in neon red color. It was developed to provide day and night protection for men engaged in

(Continued on page 130)

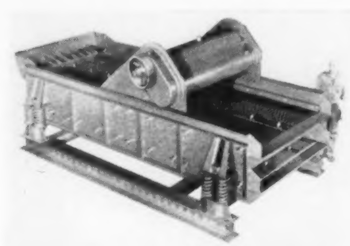
EQUIPMENT MATERIALS and METHODS

(continued)

emergency roadside operations, and for truck overhang warning. In addition to greater day and night visibility, it features the economy of durable nylon material with sewed edges, easy economical cleaning, no whipping because of double hemming, and fade resistance because the nylon thread is dyed before weaving. "Saflag" has been designed for use by truck fleets, highway departments, road contractors, public utilities, airports, and school safety patrols. **Davis Emergency Equipment Co., Inc., CE-7, 47 Halleck St., Newark, New Jersey.**

Horizontal Vibrating Screen

A NEW HEAVY DUTY straightline horizontal vibrating screen, CL-Model 58, has been announced. Designed for dewatering, washing and sizing a wide variety of materials, where head room is limited, the screen can be cable suspended or floor mounted. Where conditions warrant, a combination of both mountings can be used. It achieves a high intensity motion by centrifugal force, unbalanced shaft vibrators. Two eccentric shafts in the vibrator, supported by heavy duty oversize self-aligning bearings, are rotated by a helical gear speed reducer, giving the screen its straightline motion which is so effective in a wide variety of



Vibrator Gear Mounting

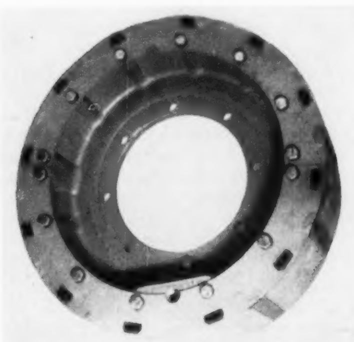
screening applications. An outstanding feature of the screen is the vibrator gear mounting. To facilitate easy removal for quick replacement of cartridge-mounted bearing, the gears are mounted on tapered shafts. A positioning rod, provided with the screen, enables maintenance personnel to support the shaft during any bearing change and keep it in a central position, thus avoiding the aggravation of re-positioning a dropped shaft. The screen decks are bolted to side plates. When a deck is worn and has to be replaced, it can be removed simply without the trouble of taking out the entire screen frame. **Link-Belt Company, CE-7, Dept. PR, Prudential Plaza, Chicago 1, Ill.**

EQUIPMENT MATERIALS and METHODS

(continued)

Full Circle Brake

A NEW HEAVY DUTY, full circle brake for off-the-road equipment has been developed. Named the "Hi-Torque," it is the first hydraulic drum type brake with 360-deg expander tube actuation designed exclusively for large tractors, scrapers and earth-movers. The brake operates with nearly constant lining pressures at all points around the drum area, at only one-half the usual maximum living pressure encountered with anchored shoe brakes. According to the manufacturer, built-in automatic adjustment assures constant braking efficiency throughout the life of the lining. It has more lining contact area than any other brake of equal size. On-the-job tests show extremely low maintenance and slow lining wear. The Hi-Torque is said to be unusually simple and easy to service. It requires no lubrication, eliminates mechanical shaft or cam alignment problems and can be disassembled with only standard hand tools. Lining changes are accomplished with only a screw driver and mallet. Made in most popular sizes, the brake is bolted as a single unit to the axle or axle housing of the vehicle and uses either the existing air supply or hydraulic power from the central system. **B. F. Goodrich Aviation Products, CE-7, Troy, Ohio.**



Easy To Service

Heavy-Duty Column

A NEW "SPACE SAVER" column that supports more weight in relation to the steel and concrete used and the area displaced, has been introduced. Modern and trim in appearance, it is a unique composite of hot rolled steel sections and concrete fill. In the manufacture of this new

(*Continued on page 132*)

EQUIPMENT MATERIALS and METHODS

(continued)

heavy-duty column, steel plates are welded to the flanges of the beam to form a square column. The column is then filled with concrete by a special method. In making full use of steel and concrete, the company has developed a column with approximately equal strength on both axis. Substantial savings are realized by using the columns, including: savings in area occupied; economical use of steel; full use of concrete, and greater column efficiency in handling eccentric loads. **Shlagro Steel Products Corp., CE-7, Somerville, Mass.**

Rotatool

A WHOLE NEW CONCEPT of drilling is opened with a percussion tool that does its work at the bottom of the hole. The Rotatool makes possible fast, economical drilling in hard rock formations that stop ordinary rotary drills, permitting operation in locations where cost factors formerly prevented profitable production. The new tool, developed for use with Schramm Rotadrills, is simple in design,

Rugged Construction

having only three moving parts. Its rugged construction assures long life and low cost of maintenance. It has a heavier hammer and therefore produces greater fracturing action for faster penetration. Since the percussive action is completely contained within the tool, no power is lost through the drill pipe. A special bit equipped with six carbide tips is designed

(*Continued on page 133*)

EQUIPMENT MATERIALS and METHODS

(continued)

for maximum life with minimum wear, and can be reground on the job for repeated use. Straighter, cleaner holes are possible with the Rotatool as a result of its rigidity, length, force of impact and hole cleaning ability. Unrestricted air passages in the tool permit the full capacity of the air compressor to pass through the bit to clear the hole of cuttings or water. **Schramm, Inc., CE-7, 900 East Virginia Avenue, West Chester, Pa.**

Vibratory Compactors

PRODUCTION OF NEW, ONE-MAN vibratory compactors has been announced. They are available in two sizes and will handle many soils including most silts, sand, gravel, rock and hot or cold asphaltic mixes. Tests show that the compactors easily produce 90 to 100% standard or modified Proctor densities, meeting the most rigid requirements. Equipped with semi-pneumatic wheels, the units have a forward speed of 20 to 45-ft per min and can be used with shoes in sizes of 12, 18, 24-in. or a special asphalt water plate which prevents asphalt from sticking to the bottom of the shoe. They are easy to maneuver and permit compacting against abutments, in trenches and in other working areas where space is limited. The contractor can eliminate compressors, air hammers and rollers. **Master Vibrator Company, CE-7, 1752 Stanley Ave., Dayton, Ohio.**

Easily Portable

Literature Available

Hydrous Alumina Silicates—Bulletin 1257 describes a full line of selectively mined and specially refined Hydrous Alumina Silicates. Available as fillers for a wide variety of industrial uses, Micro-cite, Ser-X, and Ser-A-Sil are processed on specially-designed equipment to carefully controlled particle-size distribution. The brochure summarizes their chemical properties, compatibilities, physical properties, dehydration reactions, and particle-size distribution and gives a detailed description of each product. It explains that these sericite minerals are all highly inert and have a neutral pH factor because of their primary origin and the company's special alteration methods. Their wide versatility of application is specified on a comprehensive chart. **Summit Mining Co., CE-7, Carlisle, Pa.**

Gilsulate Insulation—Presented in this technical bulletin are data for 3 grades of Gilsulate—specially selected, sized and blended Gilsonites mined from the ground at the company's properties in Eastern Utah. Section 1 gives a method of determining ditch size and the resultant size of the Gilsulate envelope for single pipes or any combinations of pipes from 1-in. to 12-in. nominal diameter: Section 2 contains insulation efficiency data; and Section 3 presents technical data and a routine mathematical procedure for predicting Gilsulate performance. Also available is a 4-page pamphlet which gives eight reasons to use and specify Gilsulate. **American Gilsonite Company, CE-7, 134 W. Broadway, Salt Lake City, Utah.**

Interlocked Armored Cable—According to this 16-page brochure, Armorlokt is an economical, flexible and compact power cable, which is insulated with rubber-varnished cambric or asbestos. It is used by pulp and paper mills, industrial plants, power generating stations, and automobile assembly plants. Some of its advantages are: lower installation cost, increased current capacity, ease of maintenance, layout flexibility, and greater accessibility to cables. **American Steel & Wire, Division of United States Steel Corp., CE-7, Rockefeller Building, Cleveland 13, Ohio.**

Truck Mixers—Some of the many features of Transcrete Truck Mixers which are discussed in this booklet are: automatic drum brake, eliminating kick-back; hard-faced bead weld on blade edge which adds life; self-aligning bearings on all mixer controls, eliminating binding; forged alloy steel drum rollers which are fully adjustable; single direction hydraulic shock absorber; and sturdy water tanks with die-formed heads. Clear-cut photographs are included. **Construction Machinery Company, CE-7, Waterloo, Iowa.**

Literature Available

Venturi Meter Tubes—A comprehensive technical bulletin describing the various types of Venturi Tubes, their recovery characteristics, the formulae that determine their design, typical calculations, and similar data is now being offered. The booklet includes a discussion of all aspects to be considered in Venturi design, vital installation instructions, the economics of Venturi metering, the various accessories available, and complete specifications. It is illustrated with diagrammatic sketches, comparison charts and graphs, installation drawings, dimensional data, and capacity tables. **B-I-F Industries, Inc., CE-7, 345 Harris Avenue, Providence, R. I.**

Framing Anchors—Entitled "16 Uses & Design Data for Trip-L-Grip Framing Anchors", this new eight-page booklet shows all pertinent data to plan and use the anchors for a variety of secondary connections with 2-in. or larger lumber. It contains information for specification writing, tables of recommended safe working values and maximum joist spans, and applications for efficient joining of 2 x 4 to 2 x 12-in. members in wood construction. Sixteen popular applications for the anchors are illustrated, with information as to type of anchor, placement, and recommended design practice for each use. These include the two most widely used applications; as joist hangers in floor and ceiling joist framing and for roof anchorage. **Timber Engineering Company, CE-7, 1319 Eighteenth St., N.W., Washington 6, D. C.**

Concrete Handling Bucket—Some of the features included in this pamphlet about concrete handling buckets are: bucket hangs vertical regardless of load; off center spout will pour into forms against adjoining walls; bucket bottom is shaped to prevent bridging; operating handles top and bottom, both sides; and Sheargate Spout varies from 0 to wide open. Specifications and prices are also mentioned. **Fitzgerald Engineering Co., Inc., CE-7, P. O. Box 289, Coral Gables, Fla.**

Sewage Lift Stations—A 100-page Engineering Data Manual on factory-built sewage lift stations—pneumatic ejector and pump—is now available. It contains design notes, selection charts, dimension drawings, suggested specifications, list of installations, installation and operating instructions and other useful information. Standard lift stations range in capacity from 20-gpm to 4000-gpm. Also available is a 20-page Data Manual on "Oxigest" Factory-built Sewage Treatment Plants for housing developments, schools, motels, and restaurants. The manual contains design notes, selection charts, engineering drawings and suggested specifications. **Smith & Loveless, Inc., CE-7, Lenexa, Kansas.**

Films Available

"Prestressed Concrete Methods"—This film shows the basic methods involved in the prestressing of bridge beams, piling, double T's and also shows the production of some of the largest prestressed girders ever cast. The motion picture is available to anyone in the construction industry at no charge. **Food Machinery & Chemical Corp., Florida Division, CE-7, Lakeland, Florida.**

"A Matter of Record"—A new 16-mm 20-min color-sound motion picture highlights the use of "Michigan" Tractor Shovels in municipality work. The film shows how municipalities across the country find the "Michigan" useful in performing many different jobs—sanitary landfill operations, snow removal, loading sand and gravel fill, backfilling trenches, ripping up old pavement, handling road shoulder maintenance, and other city improvement projects. **Construction Machinery Division, Clark Equipment Co., CE-7, Pipestone Road, P. O. Box 599, Benton Harbor, Mich.**

"Twice for the Money"—A new 17-min, 16mm color, sound film has been produced to further inform contractors about the uses and construction methods of pole buildings and to help them present the pole building story to customers. It shows a huge industrial building under construction and many examples of industrial applications of pole-type construction. Actors portray the individuals in industrial firms concerned with approving a new type of building, and the contractors who could be erecting them. **The Dow Chemical Company, CE-7, Midland, Mich.**

"This Is Flexoprint"—The 16-min, 16-mm color motion picture points out the many advantages of using Flexoprint to produce or revise lists of all kinds. It demonstrates the time, cost and work-saving advantages of the product as compared with the expensive typesetting method. Anyone concerned with producing lists of any kind has been invited to use this film free of charge. **Remington Rand, Division of Sperry Rand Corp., CE-7, 315 Fourth Ave., New York 10, N. Y.**

"Run Crane, Run"—A new 16mm, sound, color film is now available. The running time is 25-min. The picture highlights design and operating features of the newest Lorain shovel-crane, the 7-ton, ⅜-yd, Self-Propelled Lorain SP-107. It depicts the many on-the-job advantages of its 4-wheel drive, 4-wheel steer carrier getting to and around the job and its smooth, powerful digging and lifting action produced through its hydraulically controlled turntable. **The Thew Shovel Co., CE-7, Lorain, Ohio.**

From the MANUFACTURERS

MERGERS: Merger of the Hyster Co. of Portland, Ore., with the Martin Machine Co. of Kewanee, Ill., has been announced . . . Approved by the Armco stockholders at their annual meeting was the merger of Armco Steel Corp. and the National Supply Co. . . . **HYDROELECTRIC GENERATORS:** Three 19,200-kw hydroelectric generators are under construction at the Westinghouse Electric Corp., Sunnyvale, Calif., plant for the Portland General Electric Co. in Ore. These units will help the utility keep pace with the rapidly expanding demand for industrial, commercial and residential power . . . **JET FUEL PIPELINE:** Construction of the first jet fuel pipeline to service the entire jet fuel requirements of the Hunter Air Force Base from the Savannah, Ga., port, has been announced by the Georgia Pipe Line Co. The 6-in. pipeline, approximately 9.5-mi in length will cut across Savannah in a southwesterly direction to serve the Air Forces with a minimum of about 300,000-gal of jet fuel per day . . . **DISTRIBUTORS APPOINTED:** The Quaker Rubber Div., H. K. Porter Co., Inc., recently announced the appointment of two Texas firms as stocking distributors of Quaker's Industrial Rubber Products. The F. W. Heitman Co., of Houston, will be the distributor in the Harris County area, and the Jess McNeel Machinery Corp., of San Antonio, will cover the San Antonio, Austin, West Texas, and Rio Grand Valley areas . . . **OPERATIONS CENTRALIZED:** The Charles Bruning Co. has announced that it has completed a 307,100 square foot plant in suburban Mount Prospect, Ill. . . . **NEW OFFICE:** The opening in New Orleans of the Sika Chemical Corporation's ninth district office has been announced. The company manufactures and sells a complete line of concrete additives for improving the quality of concrete, and for waterproofing . . . **NEW PLANTS:** A new million dollar plant for the manufacture of sensitized materials has been built by the Ozalid Div. of General Aniline & Film Corp. Located on the outskirts of Los Angeles, the new installation will serve eleven western states and part of Texas, also Alaska, Western Canada and Hawaii . . . A major phase of construction nears completion at the new multi-million-dollar plant of the Lehigh Portland Cement Co., Miami, Fla., as the second of two banks of silos takes shape. The two banks, containing 15 silos each, will have a total storage capacity of 450,000 barrels of cement. The combined structure is 124-ft high, 225-ft long and 169-ft wide. Each of the 30 silos is 32-ft in diameter . . . **APPOINTMENTS:** J. E. Carr has been made the manager of the industrial division of The Oliver Corp., with headquarters at the company's Cleveland plant . . . Spanall of the Americas, Inc. has appointed Matthew Glen Robertson as Vice-President and General Manager.

PROCEEDINGS AVAILABLE

For instructions and key to abbreviations, see next page. Each member is entitled to 100 different "Proceedings Papers" yearly, ordered from these pages, plus all papers of the Technical Divisions in which he registers. The latter papers will be mailed automatically. Discussion of a paper will be received during the four full months following the month of issue.

JUNE

1658. A Water-Borne Runway, by David Williams. (AT) This paper describes a method of building a runway in which the concrete surface is supported on shallow thin-walled rubber water-bags. Heavy wheel loads are thus transformed into a small uniform hydrostatic pressure on the foundation soil. The constructional problem is examined and model tests are described.

1659. Airport Approach, Runway and Taxiway Lighting Systems, by C. Edward Walter and Vincent J. Roggeveen. (AT) This paper describes various systems of approach, threshold, runway, and taxiway lights. These are evaluated by means of a set of design criteria developed from a series of principles of guidance needed by an aircraft pilot.

1660. Regulation of Lake Ontario, by Franklin F. Snyder and Robert H. Clark. (HY) The physical characteristics of the Great Lakes, the hydrology of Lake Ontario, and regulation studies of the Great Lakes during the past half century are outlined. Latest international studies for regulation of Lake Ontario are described.

1661. Northeastern Floods of 1955: Meteorology of the Floods, by Charles S. Gilman and Kendall R. Peterson. (HY) This paper, one of three of a symposium, examines physical reasons for occurrence of the rainfall. Part of the explanation is the connection between rain-producing and energy-producing processes; another is the inertia of the winds. A series of maps is presented which illustrates these processes.

1662. Northeastern Floods of 1955: Rainfall and Runoff, by Tate Dalrymple. (HY) This second paper in the symposium lists peak discharges for selected gaging stations, and a comparison is made with the rainfall causing them. A comparison is also made with past floods and some indication of the frequency of the floods is presented.

1663. Northeastern Floods of 1955: Flood Control Hydrology, by Elliot F. Childs. (HY) This third paper describes the meteorology, flood discharges, and the effect of these events on hydrologic design criteria for flood control structures.

1664. Skin Friction Experiments on Rough Walls, by G. M. Sanks. (HY) Rough, flat plate skin friction at high Reynolds numbers is shown to be determinable from experiments at moderate Reynolds numbers in an identically roughened pipe. The effect of peripheral wires on skin friction in a pipe is correlated with the measured drag of a circular cylinder on a plane wall.

1665. Sewage Pumping, by H. H. Benjes. (SA) This paper describes pumping equipment, including types of pumps, and illustrates standard terms used in specifying pump characteristics and mechanics of pump selection.

1666. Highway Engineers and Pipeliners can Solve Mutual Problems, by C. D. Richardson. (PL) The ever-increasing pipeline and highway systems in the United States have magnified the mutual construction problems of highway engineers and pipeliners. Examples demonstrate benefits available to all from mutual cooperation.

1667. Flow Equations for Natural Gas Pipelines, by R. F. Bukacek. (PL) Flow equations used in the natural gas transmission industry are examined in relation to their application. Factors determining resistance to flow are related to the operating conditions of natural gas pipelines to show the limitations inherent in any practical flow equation.

1668. Engineering Uses of Sonne Strip Photography, by John H. Wolvin. (PL) Design features of the Sonne aerial camera are reviewed as an aid to the understanding of unique performance features. Specific examples of engineering uses are stated together with suggested flight specifications. Uses of stereo photography for determination of terrain cross sections are covered.

1669. Municipal Financing of Airports, by Rollin F. Agard. (AT) Municipal government has played an important role in the development of the aviation industry by providing a system of airports financed primarily from bond issues. Substantial sums will be needed to provide facilities for increasing air traffic. Airlines and other users must assume a greater portion of the cost of providing and operating these facilities.

1670. Underground Power Plants in Canada, by A. W. F. McQueen, C. N. Simpson, and I. W. McCaig. (PO) This paper presents factors affecting design practice in Canada and describes two large underground powerhouses at present under construction in the Province of Quebec. Reference is made to the Kemano development in British Columbia.

1671. Kenney Dam and Cheakamus Dam in British Columbia, by William G. Huber. (PO) Site and materials data, design criteria, construction procedures and some performance records are presented in this paper on two zoned rockfill dams in British Columbia, one founded on rock and the second on a mud slide.

1672. Box Canyon Hydroelectric Project, by Arthur P. Geuss. (PO) Design and construction of the main spillway dam of the Box Canyon Project is described in this paper, together with other project features including the powerhouse, diversion tunnel, forebay channel, and auxiliary spillway.

ORDER FORM PROCEEDINGS

(For ASCE member use only)

American Society of Civil Engineers
33 W. 39th St., New York 18, N. Y.

Please send me the Proceedings Papers which I have circled below.

1658	1662	1666	1670	1674	1678	1682	1686	1690
1659	1663	1667	1671	1675	1679	1683	1687	1691
1660	1664	1668	1672	1676	1680	1684	1688	
1661	1665	1669	1673	1677	1681	1685	1689	

If more than one copy of a paper is desired *(for which a charge of 25¢ per copy will be levied)* indicate here: ....

Please send me *(at a cost of $1.50 EACH)* the circled Division Journals:
June: Air Transport, Hydraulics, Sanitary, Power, Pipeline.

Name *(please print)* ....Membership Grade...................

Address ....City ....

State ....Date ....

1673. Pipeline Field Welding and Quality Control Methods, by A. G. Barkow. (PL) History of pipeline-laying in the United States is traced, with emphasis on the application of welding. Welding technique, specialized equipment associated with welding, qualification procedures, and non-destructive test methods are examined.

1674. Future Prospects for International Pipelines, by William R. Connole. (PL) Although international pipelines are now physically possible, considerations of national self-interest must be settled first. A re-examination and clear statement of policy by both Canada and the United States must precede random expansion of international pipelines.

1675. Underground Power Plants in Scotland, by C. M. Roberts. (PO) The development, layout and construction of the Ceannacroc and Glenmoriston underground power plants in Northern Scotland is described. Tunneling methods, access and ventilation, surge arrangements, migratory fish and flood control provisions are examined.

1676. Civil Engineering Features of Linden Generating Station, by A. Verduin. (PO) The paper illustrates the civil engineer's role in the design and construction of a major steam electric generating station. This station is unique because of the interchange of extraction steam for refining residuals with a nearby oil refinery.

1677. SED Research Report No. 18: Municipal Incinerator Design, A Survey of Engineering Practice. (SA) This paper presents a survey of 110 cities in the United States using incinerators. Evaluation of construction trends and costs are presented along with design data and operation information.

1678. SED Research Report No. 19: Sewage Treatment by Lagoons. (SA) This report covers the economy and space involved in this method of treatment. Data and information are presented on installations and design criteria.

1679. Sewage Effluent Used for Industrial Water, by Thomas F. Sullivan. (SA) The paper describes the water and sewage effluent available and means used to overcome undesirable constituents to produce a water capable of performing the task assigned to it.

1680. Organization of Metropolitan Districts, by Langdon Pearse. (SA) Examples of cooperative action by municipalities are the New York Port Authority and The Metropolitan Sanitary District of Greater Chicago. Data are given on such organizations in the United States and Canada, including interstate pollution control agreements.

1681. Effects of Aeration Period on Modified Aeration, by Wilbur N. Torpey and Martin Lang. (SA) Five years of operating data are analyzed to find the effect of the aeration period on process efficiency and air consumption. A region of operation from zero aeration period to the minimum necessary for full process efficiency is defined.

1682. Design of Water Supply Structures, by Howard J. Carlock. (SA) The paper is a resume of seven subjects related to water supply and representing ideas that engineers are continually developing to further improvements in design.

1683. Performance and Maintenance of Dix River Dam, by Lewis A. Schmidt, Jr. (PO) Constructed to a height of 275 feet in 1923-25, Dix Dam was then the highest rockfill dam built. Accumulated data on leakage, maintenance, condition and settlement are presented for applicable consideration in the design of future projects similar to the Dix River Dam.

1684. The Turbulent Boundary Layer in a Conical Diffuser, by Harvey R. Fraser. (HY) A method for turbulent boundary layer calculations in a smooth walled conical diffuser is proposed, based on the analysis of the boundary layer in two distinct regions and involving only the solution of algebraic equations.

1685. Salaries of Local Environmental Health Personnel in 1956, Report of the Committee on Salaries. (SA) This report is the second in the series covering the salary status of the environmental health personnel in 1956.

1686. A Study of Sewage Collection and Disposal in Fringe Areas: Second Progress Report of the Committee on Public Health Activities. (SA) In this Second Progress Report, the Committee presents Appendices B, C, D, and E to supplement the First Progress Report published as Proceedings Paper 1613 in the April, 1958 Journal of the Sanitary Engineering Division.

1687. Cogswell and San Gabriel Rockfill Dams, by Paul Baumann. (PO) Features of interest attending the design, construction and performance of two rockfill dams are treated in this paper. Attention is paid to such novel features in the design and construction as have proved to be advantageous and successful.

1688. Discussion of Proceedings Paper 1408, 1461, 1463, 1533. (SA) Alex N. Diachishin on 1408. C. J. Posey on 1461. J. Fleming Dias on 1463. H. E. Hudson, Jr. on 1533.

1689. Discussion of Proceedings Paper 1457, 1488, 1529, 1554, 1555. (PO) D. J. Bleifuss, F. L. Lawton, Pierre E. Danel and Jean Rueff on 1457. D. I. H. Barr on 1488. F. L. Lawton on 1529. F. L. Lawton on 1554. F. L. Lawton on 1555.

1690. Discussion of Proceedings Paper 1449, 1451, 1453, 1454, 1455, 1528. (HY) M. B. McPherson, J. W. Forster on 1449. H. C. Riggs and Manuel A. Benson on 1451. Steponas Kolupaila, Ralph W. Powell, John W. Paull, Iwao Oki on 1453. R. E. Templeton and T. E. Stelson on 1454. Madhav Manohar, Fred W. Blaisdell, W. T. Moody, Jean Rigard, M. B. McPerson, Steponas Kolupaila on 1455. Edward Silberman on 1528.

1691. Discussion of Proceedings Paper 1375, 1667. (PL) A. B. Wilder on 1375. Leon E. Brooks closure to 1375. James H. Dorough on 1667.

INSTRUCTIONS

1. Every ASCE member can be registered in two of the Technical Divisions and receive automatically all papers sponsored by those Divisions. **Such registration will be effective 30 days after the receipt of the registration form.**

2. In addition to those papers sponsored by the Divisions in which he is registered, a member is entitled to 100 different papers during a fiscal year beginning October 1.

3. Members' accounts will be charged 25¢ each for additional duplicate copies of a paper and for papers in excess of his free allotment.

4. Papers should be ordered by serial number. The member should keep a record of papers ordered to avoid unwanted duplication.

5. Non-members of the Society may order copies of Proceedings papers by letter with remittance of 50¢ per copy; members of Student Chapters, 25¢ per copy.

Standing orders for all Papers in any calendar year may be entered at the following annual rates: Members of ASCE, $15.00; members of Student Chapters, $15.00; non-members, $40.00; libraries, $25.00.

TRANSACTIONS. Specially selected PROCEEDINGS papers with discussions will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the current established annual subscription rates.

	To Members	To Non-Members
Morocco-grained binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

KEY TO TECHNICAL DIVISION SPONSORSHIP

(AT) Air Transport
(CP) City Planning
(CO) Construction
(EM) Engineering Mechanics
(HW) Highway
(HY) Hydraulics
(IR) Irrigation and Drainage
(PL) Pipeline
(PO) Power
(SA) Sanitary Engineering
(SM) Soil Mechanics and Foundations
(ST) Structural
(SU) Surveying and Mapping
(WW) Waterways and Harbors

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

EASTERN

DIVISION ENROLLMENT FORM

American Society of Civil Engineers

33 West 39th Street, New York 18, New York

☐ I am already enrolled
or
☐ I wish to be enrolled
in the ....
Division and receive automatically the Journal of that Division.

In addition, I wish to be enrolled in the
....
Division and receive automatically the Journal of that Division.

(Signature)

(Please print name) (Membership grade)

PLEASE PRINT MAILING ADDRESS ONLY

(Number and Street)

(City) (Zone) State

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

MODJESKI AND MASTERS
Consulting Engineers
F. M. Masters
G. H. Randall — **J. R. Giese**
C. W. Hanson — **H. J. Engel**
Design and Supervision of Construction
Inspection and Reports
Bridges, Structures and Foundations
P.O. Box 167 — **Philadelphia, Pa.**
Harrisburg, Pa. — **New Orleans, La.**

AERO SERVICE CORPORATION
Integrated surveying and mapping services—including soils and sub-surface studies—for Highways, Water Supply, Dams, Airports, Municipal Developments, and other large engineering projects. Also associated electronic computing services.
210 E. Courtland St., Philadelphia 20, Pa.

ALBRIGHT & FRIEL INC.
CONSULTING ENGINEERS
Water, Sewage, Industrial Wastes and Incineration Problems, City Planning, Highways, Bridges and Airports, Dams, Flood Control, Industrial Buildings, Investigations, Reports, Appraisals and Rates
Three Penn Center Plaza
Philadelphia 2, Pa.

LAWRENCE T. BECK AND ASSOCIATES
Engineers and Consultants
Philadelphia — New York — Washington

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin — **Neville C. Courtney**
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St. — **Philadelphia 7, Pa.**

H. A. KULJIAN & COMPANY
Engineers and Architects
Power Plants (steam, hydro, diesel)
Industrial Buildings • Army & Navy Installations • Airports, Hangars
Water and Sewage Works
Design • Investigations • Reports • Surveys
1200 No. Broad St. — **Phila. 21, Pa.**

YULE, STICKLEN, JORDAN & McNEE
Engineers
Highways, Bridges, Airports
Design, Investigations, Reports
Supervision of Construction
Civil, Structural, Mechanical, Electrical
23rd and Markets — **309 South Broad St.**
Camp Hill, Pa. — **Philadelphia 7, Pa.**
5564 North High St.
Columbus, Ohio

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants • Warehouses
Commercial Buildings • Office Buildings
Laboratories • Steel and Reinforced
Concrete Design • Supervision
Reports
1150 Century Bldg., Pittsburgh 22, Pa.

MORRIS KNOWLES INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., — **Pittsburgh 22, Pa.**

PENNSYLVANIA DRILLING COMPANY
Subsurface Explorations, Grouting
Industrial Water Supply, Mineral Prospecting
Large Diameter Drilled Shafts
Reports
1205 Chartiers Ave. — **Pittsburgh 20, Pa.**

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys • Design • Supervision
Sanitary Engineering
Industrials and Utilities
Domestic and Foreign
525 Lancaster Avenue, Reading, Pa.
New York • Washington

MICHAEL BAKER, JR., INC.
The Baker Engineers
Civil Engineers, Planners, and Surveyors
Airports, Highways, Sewage Disposal Systems, Water Works Design and Operation, City Planning, Municipal Engineering, All Types of Surveys
Home Office: Rochester, Pa.
Branch Office
Jackson, Miss. — **Harrisburg, Pa.**

SPRAGUE & HENWOOD, INC.
Foundation Investigations • Soil Testing and Test Borings • Grout Hole Drilling and Pressure Grouting • Diamond Core Drilling
Scranton, Pa. — **New York, N. Y.**
Philadelphia, Pa. — **Grand Junction, Colo.**
Pittsburgh, Pa. — **Atlanta, Georgia**
Buchans, Newfoundland

BUCHART ENGINEERING CORP.
Consulting Engineers
Highways—Bridges—Sewer Systems—Surveys—Water Works—Dams—Reports—Supervision—Industrial—Municipal—Structures
55 S. Richland Ave., York, Pa.
Lancaster, Pa. — **Washington, D. C.**

C. W. RIVA CO.
Edgar P. Snow — **John F. Westman**
Highways, Bridges, Tunnels, Airports, Sewerage, Water Supply, Soil Tests, Reports, Design and Supervision
511 Westminster St. — **Prov. 3, R. I.**

MID-WESTERN

ALVORD BURDICK & HOWSON
Consulting Engineers
Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals
20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control and Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas and Electric Transmission Lines
360 E. Grand Ave., Chicago 11, Illinois
9½ Indiana St., Greencastle, Ind.

GREELEY AND HANSEN
Water Supply, Water Purification, Sewerage, Sewage Treatment, Refuse Disposal, Industrial Wastes
220 S. State Street, Chicago 4, Illinois

DeLEUW, CATHER & COMPANY
Consulting Engineers
Public Transit — Subways
Traffic & Parking — Railroad Facilities
Expressways — Industrial Plants
Grade Separations — Municipal Works
Urban Renewal — Port Development
150 North Wacker Drive, Chicago 6
San Francisco — Toronto — Oklahoma City

HARZA ENGINEERING COMPANY
Consulting Engineers
Calvin V. Davis — **E. Montford Fucik**
Richard D. Harza
Hydroelectric Plants and Dams
Transmission Lines
Flood Control, Irrigation
River Basin Development
400 West Madison Street — **Chicago 6**

C. MARTIN RIEDEL
Consulting Engineer
Chemical Soil Solidification Engineering for:
Tunnels, Shafts, Mines, Foundations
Underground Structures
7650 S. Laflin St. — **Chicago 20, Illinois**
Tel: Vincennes 6-6022, -23

SOIL TESTING SERVICES, INC.
Consulting Engineers
John P. Gnaedinger — Carl A. Metz
Sub-Surface Investigations, Laboratory testing, Inspection, Engineering Reports And Design of Foundations
1827 No. Harlem Ave., Chicago 35, Ill.
Kenilworth, N. J.—San Francisco, Calif.
Vedado Hana, Cuba

STANLEY ENGINEERING COMPANY
Consulting Engineers
208 S. LaSalle Street — **Hershey Building**
Chicago 4, Illinois — **Muscatine, Iowa**

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Municipal Improvements — Sewerage
Power Development — Water Systems
Traffic Surveys — Industrial Plants
Flood Control — Recreational Facilities
Airports — Investigations and Reports
805 East Miller Street
Springfield, Illinois

NED L. ASHTON
Consulting Engineer
Aluminum and Steel Structures
Bridges and Paraboloidal Antennas
Swimming Pools and Foundations
Welded Design and Strengthening
820 Park Road — **Iowa City, Iowa**

BLACK & VEATCH
Consulting Engineers
Water, Sewage, Electricity, Industry, Reports, Design Supervision of Construction Investigations, Valuation and Rates
1500 Meadow Lake Parkway
Kansas City 14, Missouri

BURNS & McDONNELL
Engineers • Architects • Consultants
Kansas City, Missouri • P.O. Box 7088
Phone: DElmar 3-4375

GUNITE CONCRETE & CONSTRUCTION COMPANY
Engineers • Cement Gun Specialists • Contractors
Linings, Encasing, Insulating, Repairing, Fireproofing, New Construction
1301 Woodswether, Kansas City 5, Mo.
2016 W. Walnut, Chicago 12, Ill.
1004 Market St., St. Louis 1, Mo.
3206 Houston, Houston 9, Texas
1136 W. Orangethorpe, Fullerton, Calif.
Milwaukee—Denver—New Orleans

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges, Structures, Foundations
Express Highways
Administrative Services
1805 Grand Avenue — **99 Church Street**
Kansas City 6, Mo. — **New York 7, N. Y.**

SVERDRUP & PARCEL, INC.
Engineers • Architects
Bridges, Structures and Reports
Industrial and Power Plant Engineering
915 Olive Street, St. Louis 1, Mo.
417 Montgomery Street,
San Francisco 4, Cal.

A. L. ALIN
Consulting Engineer
5927 N. 24 Street
Omaha 10, Nebraska
Dams, Hydroelectric Power
Flood Control

HAZELET & ERDAL
Consulting Engineers
Design, Supervision, Investigations, Reports
Fixed Bridges — Movable Bridges
Expressway Systems — Harbor Works & Dams
Dixie Terminal Bldg., Cincinnati 2, O.
Monadnock Block, Chicago 4, Ill.
Oding Bldg., Lansing 33, Mich.
Commerce Bldg., Louisville 2, Ky.

VOGT, IVERS, SEAMAN & ASSOC.
Engineers-Architects
Highways — Structures — Expressways
Industrial Bldgs. — Harbor Facilities
Airports — Dams — Docks
Surveys — Reports
34 W. Sixth St., Cincinnati 2, O.
20 N. Wacker Dr., Chicago 6, Ill.

THE AUSTIN COMPANY
Design • Construction • Reports • Plant Location Surveys • Domestic and Foreign Work
16112 Euclid Avenue, Cleveland, Ohio
New York — Detroit — Oakland
Chicago — Houston — Seattle
Los Angeles

HAVENS AND EMERSON
W. L. Havens — **A. A. Burger**
J. W. Avery — **H. H. Moseley**
F. S. Palocsay — **E. S. Ordway**
Frank C. Tolles, Consultant
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuation, Laboratories
Leader Bldg. — **Woolworth Bldg.**
Cleveland 14, O. — **New York 7, N. Y.**

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

THE OSBORN ENGINEERING COMPANY
Designing • Consulting
Industrial Plants — Office Buildings
Stadiums — Grand Stands — Field Houses
Bridges — Garages — Laboratories
7016 Euclid Ave. — Cleveland 3, Ohio

ALFRED H. GRUPPE
Consulting Engineer
Design and Construction Supervision of Bridges, Buildings, Foundations, Concrete and Steel Structures
828 N. Broadway
Milwaukee 2, Wisconsin

SOUTHERN

PALMER & BAKER, ENGINEERS, INC.
Consulting Engineers and Architects
Tunnels, Bridges, Highways, Airports, Industrial Buildings, Harbor Structures, Soils, Materials and Chemical Laboratories
Mobile, Ala. — New Orleans, La.
Washington, D. C.

PRESSURE CONCRETE COMPANY
Engineers and Gunite Contractors
Design and Construction of Prestressed Tanks and Swimming Pools
Gunite Restoration and Repairs to Concrete Structures
1555 Helton Street, Florence, Alabama

HAYNES AND EDWARDS
Consulting Engineers
PRESTRESSED CONCRETE DESIGN
Buildings—Bridges
Complete Prestress Plants
Box 1053 — Lakeland, Florida
MUtual 8-5631

EUSTIS ENGINEERING COMPANY
Foundation and Soil Mechanics Investigations
Soil Borings — Laboratory Tests
Foundation Analyses — Reports
3635 Airline Highway
Metairie, Louisiana

FROMHERZ ENGINEERS
Structural • Civil • Sanitary
Four Generations Since 1867
Water Supply, Sewerage, Structures, Drainage, Foundations, Industrial Waste Disposal, Investigations, Reports, Plans and Specifications, Supervision
816 Howard Avenue, New Orleans

PAN AMERICAN ENGINEERS
Consultants
Highways, Water, Sewerage, Gas, Drainage, Power, Municipal Works, Irrigation, Flood Control, Industrial Developments.
1022 Tenth St. — 3415 N. Acadian Thruway
Alexandria, La. — Baton Rouge, La.

WILLIAM F. GUYTON AND ASSOCIATES
Consulting Ground-Water Hydrologists
Underground Water Supplies
Investigations, Reports, Advice
307 W. 12th St. — 3301 Montrose Blvd.
Austin 1, Texas — Houston 6, Texas
Phone: GR 7-7165 — Phone: JA 2-9885

SPENCER J. BUCHANAN AND ASSOCIATES, INC.
Consulting Engineers
Soil Mechanics and Foundation Engineering, Earth Dams, Wharves, Airfields, Highways, Drainage, Structural Foundations; Reports, Design, and Field Supervision
310 Varisco Building, Bryan, Texas
Phone TAylor 2-3767

SOIL MECHANICS INCORPORATED
Foundation Exploration and Testing Services
Site Investigations, Soil Borings, Field and Laboratory Testing, Load Tests, Reports
310 Varisco Building — 11525 South Main
Bryan, Texas — Houston 25, Texas
Phone TAylor 2-3767 — Phone MOhawk 7-1869

LOCKWOOD, ANDREWS & NEWNAM
Consulting Engineers
Industrial Plants, Harbors, Public Works
Roads, Airport, Structures, Earthworks
Mechanical and Electrical
Reports • Design • Supervision
Surveys • Valuations
Corpus Christi • HOUSTON • Victoria
Texas

ENGINEERS TESTING LABORATORY, INC.
Soil Mechanics and Foundation Engineering
Soil Borings — Laboratory Tests
Foundation Analyses — Reports
2116 Canada Dry St., Houston 23, Texas
444 North 9th Street, Baton Rouge, La.

McCLELLAND ENGINEERS
Soil and Foundation Consultants
Investigation • Reports
Supervision • Borings and Tests
2649 N. Main St. — Houston 9, Texas

PRESTRESSING RESEARCH & DEVELOPMENT, INC.
Prestressed Concrete Design
Bridges — Buildings — Waterfront Structures
Arches, Shells — Domes
1511 Transit Tower, San Antonio, Texas

WESTERN

JOHN S. COTTON
Consulting Engineer
Hydroelectric, irrigation, water supply, and multiple purpose projects, flood and erosion control, river basin development planning, dams and their foundations, tunnels, marine structures, valuations, rates.
24 Evergreen Drive, Kentfield, Calif.

DAMES & MOORE
Soil Mechanics Engineering
Los Angeles • San Francisco • Portland
Seattle • Salt Lake City • Chicago
New York • Atlanta • London
General Offices, 816 West Fifth Street
Los Angeles 17, Calif.

FAIRCHILD AERIAL SURVEYS, INC.
Aerial Photography — Contour Maps
Airborne and Marine Geophysics
Highway Maps — City Maps
224 E. 11th St., Los Angeles 15
30 Rockefeller Plaza, New York 20
Chicago, Tallahassee, Boston, Geneva

HOLMES & NARVER, INC.
Engineers • Constructors
Industrial, Petroleum and Chemical,
Nuclear, Missile Facilities
828 S. Figueroa Street
Los Angeles 17, California

KAISER ENGINEERS
Division of Henry J. Kaiser Company
ENGINEER • CONTRACTOR
Investigation • Reports • Valuations
Design • Construction
Twinoaks 3-4600
1924 Broadway — Oakland, Calif.

WOODWARD, CLYDE, SHERARD AND ASSOCIATES
Soil and Foundation Engineering; Earth Dams; Engineering Geology; Highway and Airport Pavement Design
1150 28th Street Oakland, California
1240 W. Bayaud St., Denver, Colo.
Suite 310, V.F.W. Bldg., Kansas City, Mo.
4815 Dodge Street, Omaha, Nebraska

INTERNATIONAL ENGINEERING COMPANY INC.
Engineers
Investigations • Reports • Design
Procurement • Field Engineering
Domestic and Foreign
74 New Montgomery St.
San Francisco 5, California

JACOBS ASSOCIATES
Consulting Construction Engineers
Appraisal of Construction Costs • Methods Analysis • Field Engineering • Job Management • Review of Bidding Documents for Construction Economy • Engineering Geology • Plant and Equipment Design
503 Market Street
San Francisco 5, California

FOREIGN

SAENZ-CANCIO-MARTIN
Ingenieros
ALVAREZ y GUTIERREZ
Arquitectos
Consulting Engineers and Architects
Ave. de la Independencia 774
Ensanche del Vedado, Habana, Cuba

DUMONT-GREER ASSOCIATES
Architects-Engineers
Airports, Port Facilities
Public Works Projects,
Industrial, Urban, Agricultural
and Rural Development
Design and Construction Supervision
1 Rue du Rhone — Geneva, Switzerland
TELEPHONE: 24.63.87

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to members or firms where one or more of the principals are members of the

American Society of Civil Engineers

Your card should be among them.

Write Today For Rates.

Index To Advertisers

Advertising Manager
James T. Norton

Advertising Production Manager
Alice M. Doerle

33 West 39th Street, New York 18, N. Y.

Representatives

EASTERN

- Robert S. Cypher
33 West 39th Street, New York 18, N. Y.

SOUTHEASTERN

- Fred W. Smith
1201 Forest View Lane—Vesthaven
Birmingham 9, Ala.

MID-WESTERN

- Richard K. Holmstrom
84 East Randolph St., Chicago 1, Ill.

WESTERN

- McDonald-Thompson Company
625 Market St., San Francisco 5, Calif.
3727 West Sixth St., Los Angeles 5, Calif.
National Bldg., 1008 Western Ave., Seattle 4, Wash.
912 S. W. Market St., Portland 1, Ore.
3217 Montrose Boulevard, Houston 6, Texas
Colorado National Bank Bldg., Denver 2, Colo.
2010 So. Utica St., Tulsa 4, Okla.